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ERP use, control and drift: an agency perspective

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ERP Use, Control and Drift: An Agency Perspective

Ioannis Ignatiadis

A thesis submitted for the degree of Doctor of Philosophy

University of Bath
School of Management

November 2007

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Abstract

Enterprise Resource Planning (ERP) systems are information systems that integrate organizational activities across geographical and functional divisions. Being enterprise-wide systems, they are used within an organization in order to standardise its data and streamline its business processes. However, the envisaged benefits of installing an ERP system, such as better control over the company's operations and seamless integration and data exchange, often fail to materialize.

Although the literature has looked into the factors affecting a successful ERP implementation and adoption, it has largely overlooked the actual use of the system. However, as ERP systems have become widespread in many organizations, it is important to examine the use of such systems and their organizational consequences in-situ. This research is particularly concerned with the impact of the use of ERP systems on organizational control and drift. The main argument is that there are contextual factors, in the form of existing organizational control and drift, which influence the use of the ERP system by its users. The actual use of the ERP system can then also lead to organizational control or drift itself. This depends on the way the system is used by its users, as well as the affordances of the system. The former is characterized as human agency in this thesis, while the latter is characterized as machine agency.

An interpretive case study approach is adopted to examine those issues. A main case study is examined in depth, aided by four auxiliary case studies. The main contribution of this research is the provision of rich insights regarding the use of ERP systems and their organizational consequences.

Abbreviations

ABC	Activity-Based Costing
ANT	Actor Network Theory
AP	Accounts Payable
AR	Accounts Receivable
B2B	Business to Business
B2C	Business to Client
BACS	Bank Automated Clearing System
CIO	Chief Information Officer
CRM	Customer Relationship Management
CSCW	Computer Supported Cooperative Work
CSF	Critical Success Factor
CSV	Comma-Separated Values
EAI	Enterprise Application Integration
EPC	Electronic Product Code
ERP	Enterprise Resource Planning
ES	Enterprise System
FI	Finance (ERP Module)
GL	General Ledger
HR	Human Resources (ERP Module)
IS	Information System(s)
IT	Information Technology
ITCG	Information Technology Control Guidelines
KM	Knowledge Management
KPI	Key Performance Indicator
MIS	Management Information System
MM	Materials Management (ERP Module)
PP	Production Planning (ERP Module)
RFID	Radio Frequency Identification
SAF	Service Affecting Failure
SCM	Supply Chain Management
SD	Sales and Distribution (ERP Module)
SOX	Sarbanes-Oxley Act
ST	Structuration Theory
TAM	Technology Acceptance Model
WM	Warehouse Management (ERP Module)

1. Introduction

1.1. *Background*

A key characteristic of all enterprise-wide systems, such as Enterprise Resource Planning (ERP) systems, Customer Relationship Management (CRM) systems, Supply Chain Management (SCM) systems, and e-Government applications is that they transcend the organization in which they are implemented. Those systems affect a large number of organizational departments and processes, as well as external parties, such as customers or suppliers (Peppard and Ward, 2005). Their main differences from more traditional IT systems are the complexity and cross-functional scope, the range of different stakeholders involved, and the extent of business and organizational changes needed to accommodate the new business models inherent in those systems.

Perhaps the most prominent example of enterprise-wide systems in terms of organizational adoption is the ERP system. The global market for ERP software was in fact worth \$16.6 billion in 1998 (Carlino, 2000), while by 1999 53,000 firms worldwide had implemented an ERP system (Cerullo and Cerullo, 2000). By 2002, ERP adoption was 67% among medium and large companies (Scott and Shepherd, 2002), and in 2004 it was 80% among Fortune 500 companies (Meta-Group, 2004). In particular in Europe, the market for ERP vendors is predicted to increase from \$8.8 billion in 2004 to over \$12 billion in 2009 (Kara and Hewitt, 2005).

Given the increased importance of having an ERP system in an organization, it is not surprising that the academic interest in those systems grew accordingly, as indicated by publications in reputable conferences and journals (Botta-Genoulaz et al., 2005; Esteves and Pastor, 2001; Moller et al., 2005). As will be discussed in chapter 2 (literature review) however, much of the research in ERP systems is concerned with the implementation process and providing insights into success factors of ERP implementation (e.g. Akkermans and van Helden, 2002; Al-Mashari and Al-Mudimigh, 2003a; Bingi et al., 1999; Holland and Light, 1999; Hong and Kim, 2002; Nah et al., 2001; Shanks et al., 2000; Somers and Nelson, 2001). Only a few studies investigate issues relating to the post implementation of ERP Systems (e.g. Elmes et al., 2005; Sia et al., 2002). Hence we have limited understanding of issues affecting the use of ERP systems in organizations and their potential for organizational impact. As such, the purpose of this thesis is to investigate the factors influencing ERP use, and the impact of ERP use on control and drift within an organization. The focus of the research is explained in more detail in the next section.

1.2. Research Focus

1.2.1. Organizational control

Although there have been a number of studies to investigate the impact of IT on organizational control (e.g. Bloomfield and Coombs, 1992; Bloomfield et al., 1994; Coombs et al., 1992; Malone, 1997; Mansell, 1994; Orlikowski, 1991; Tang et al., 2000), our understanding of how work mediated by an ERP system in particular affects organizational control is still limited. What distinguishes ERP systems from other Information Systems is their scale, complexity, and potential for organizational impact (Laudon and Laudon, 2006; O'Brien, 2004). Implementation of an ERP system in an organization can in fact have profound impact on organizational processes (Boudreau and Robey, 1999; Koch, 2001; Martin and Cheung, 2000; Rao, 2000a; Schnederjans and Kim, 2003), as well as on information flow and transparency (Bernroider and Koch, 1999; Besson and Rowe, 2001; Gattiker and Goodhue, 2004; Legare, 2002; Markus and Tanis, 2000; Newell et al., 2003; Shang and Seddon, 2000). Because of this, ERP systems deserve greater attention with regards to their impact on organizational control.

1.2.2. Organizational drift

The number of studies examining drift from the use of an ERP system is actually non-existent. Although some studies in ERPs (e.g. Boudreau and Robey, 2005; Cadili and Whitley, 2005; Soh et al., 2000) have examined the use of ERP systems by users, this was not linked to the way it affects organizational drift (or for that matter organizational control). In addition, drift in an ERP setting has only been examined in the implementation stage (e.g. Nandhakumar et al., 2005; van Fenema and van Baalen, 2005), without looking at drift during the actual use of the system. As such, it is also important to examine organizational drift during use of an ERP system.

The next section introduces the methodology adopted in this research.

1.3. *Research Methodology*

An interpretive case-study approach is adopted in this thesis, discussed in detail in chapter 3. An extensive investigation was carried out in one company (with thirty-six interviews), which was aided by the parallel restricted examination of four auxiliary companies. As such, the research basically follows a single case study approach, aided by the high-level examination of multiple (four) case studies. The benefit of this approach is the in-depth examination of one case study, also allowing for the high-level comparison of concepts encountered in the other four companies as well.

All of the five companies were examined with semi-structured interviews, in order to be able to understand general issues with their ERP system. From these discussions some initial conceptualisations were developed, which led to the more in-depth examination of the fifth company, taking advantage of the increased access given to that company. Although the research agenda was vague at start, influenced by the general literature on ERP systems, this agenda became more focused after the initial interviews. This also led to a formulation of more specific research questions, which are summarized in the next section.

1.4. Research Questions

The research questions were not formulated a priori, but emerged after interactions with the five case study companies, and those questions were elaborated as the study progressed. These research questions are presented in section 4.7. In order to concentrate on the analysis and discussion of the main case study in chapter 5, the research questions are shown immediately after the examination of the four auxiliary cases in chapter 4, although all five companies contributed towards the development of the research questions, which are summarised below:

1. What are the key contextual factors (in the form of pre-existing control and drift) that influence the role and use of an ERP system?
2. How does the actual use of an ERP system influence organizational control and drift?

As has been mentioned above and will also be shown in the Knowledge Gap section of the Literature Review (chapter 2), the research questions are quite important in enhancing our understanding of the way ERP use is shaped by its environment and in turns impacts that environment. In order to address those questions, the dichotomies between the “social construction of technology” (Bijker et al., 1999; MacKenzie and Wajcman, 1999) and “technological determinism” (Smith and Marx, 1994; Winner, 1977) are overcome by considering humans (the users) and machine (the ERP system) as both possessing agency. Human agency in this thesis is characterised by the intentionality of users to use the system in a certain way, while machine agency is characterised by the actions that the ERP system affords to its users.

The next section summarizes the contributions of this research.

1.5. Summary of Contributions

The contributions of this research are both for theory and practice. Those are detailed in section 6.4, but are also summarised below.

1.5.1. Contributions for theory

The contributions of this research for theory include the elaboration of concepts presented in section 2.8, and their application in the case study companies presented in chapters 4 and 5.

Results from this research in particular help in conceptualising the use of an ERP system according to the characteristics of the system and the way it is used by its users. The conceptualisation also includes the dependency of ERP use on contextual factors (which are categorized in this thesis as pre-existing control and drift), as well as the actual impact of ERP use on organizational control and drift. This conceptualisation provides a better theoretical understanding of the nature of work within an ERP system, and the impact that it has on an organization, as will be discussed in chapters 4 to 6 (presentation and analysis of the case study companies and discussion of their results). As research on ERP systems tends to move away from initial implementation concerns and success factors, this thesis offers an important dimension by presenting more critical reflections on the actual use of those systems and their organizational consequences.

1.5.2. Contributions for practice

As will be discussed in section 6.4.2, the contributions of this research for practice are in helping companies become more aware of the ways that organizational control is enacted or drift is propagated by using an ERP system, also depending on various contextual factors impacting its use. The contributions then include highlighting general areas where use of the ERP system can have unintended consequences, and can lead to results contrary to the company's expectations. In that sense lessons can be learned from the rich data obtained from the examination and discussion of the case study companies in chapters 4 to 6. The companies can then determine how to best configure the ERP system and manage their users, in order to gain the maximum benefit from the use of the system.

The next section concludes the introduction to this thesis by presenting its structure.

1.6. *Structure of Thesis*

In the chapters that follow, chapter 2 carries out a review of literature relevant to this thesis, in order to identify the knowledge gap that exists and which this thesis tries to address. This chapter also includes the sensitizing devices that are used to analyze the data from this research. Chapter 3 then presents the ontological and epistemological stances of the research, together with the case study approach adopted, the data collection approach, and the methodology used for analyzing the collected data. Chapter 4 then presents and analyzes the case studies of the four auxiliary companies examined. The research questions of this study are also elaborated. These research questions were also influenced by the examination of the main case study of this research, which is analyzed and discussed in chapter 5. Chapter 6 presents the emerging themes of this research, and discusses the results from all the case study companies, by framing them in the research questions of this study. This chapter also concludes the thesis by discussing in detail the contributions of the research for theory and practice, as well as the limitations of this study and potential for future research.

2. Literature Review, Knowledge Gap and Sensitizing Devices

2.1. *Introduction*

The purpose of this chapter is to present the literature relevant to the subject of this thesis, in order to set the context for the subsequent analyses and discussions (in chapters 4 and 5), as well as to identify the knowledge gap in the literature that this thesis tries to bridge. Relevant literature discussed in this chapter is also used as a sensitizing device (Walsham, 1993) in the examination of the case study companies.

The chapter starts by presenting IT as an artefact within an organization. The focus then moves to more specific literature on ERP systems, in order to identify relevant research and determine the contribution that this thesis makes to the body of available research. As the focus of this thesis is also on control and drift, relevant literature on these two concepts is also discussed. A summary of the available literature on ERPs, control and drift is then presented, leading to the identified knowledge gap. The concepts used as sensitizing devices in this research are finally elaborated.

2.2. The IT Artefact

As Orlikowski and Barley (2001) mention, technologies are simultaneously social and physical artefacts. Hence the code phrase “the social construction of technology” refers to the role of human agency in technological change. From the implementation point of view, designers incorporate into technical systems assumptions about usage by end-users, physical considerations, design traditions, as well as taken-for granted views of the world for which the system is intended. From the usage point of view, users can shape the implications of technology as they incorporate it into everyday practices, using it in intended and unintended ways. Orlikowski (2000) in fact terms the enacted structures of technology use as *technologies-in-practice*, which she defines as the set of rules and resources that are constituted and reconstituted in the recurrent engagement of people with the given technologies. She then uses the notion of a *practice lens*, through which technology structures are emergent from the actual use of the technology. This means that people “can (and do) redefine and modify the meaning, properties, and applications of technology after development” (p. 406).

In particular in relation to Information Technology, Zuboff (1988) sees two roles for IT in organizations, which can be seen as a duality. On the one hand, IT can automate operations, replacing to a large extent the human body. On the other hand, IT can generate information about the processes through which an organization accomplishes its work. The implications in each case are different. When technology “automates”, the effects on workers are controlling and deskilling. When technology “informs”, the effects are empowerment and upskilling.

It is true however that both “automating” and “informing” aspects of IT can coexist at the same time. Bloomfield and Coombs (1992) argue that on one hand, decreasing costs and increasing availability of computer-based IS in the desks of employees can lead to an increase of employee power. On the other hand, the need for increased management control of the decentralised decision-making creates a perceived centralisation of power and control. This premise is also acknowledged by Orlikowski (1991, p. 10), who states that “... [Information Technology] facilitates decentralization and flexible operations on the one hand, while increasing dependence and centralised knowledge and power on the other”.

As the above authors mention, the degree to which the two contrasting aspects of IT prevail depends on many factors, including the organizational context where IT is used, as well as the actions and interactions of human agents. The last point is very important in this thesis, which assumes an agency perspective to explain the interplay between actions, control and drift in the context of ERP use.

Having presented issues relevant to IT as an artefact, the next section concentrates on ERP systems in particular, which are the focus of this study.

2.3. ERP Systems

The increased interest in ERP systems has been shown by a comprehensive survey carried out by Moller et al. (2005), who identified 739 articles in bibliographic databases (including conference and journal publications) referring to ERP systems, in the 5 year period between 2000 and 2004. In addition, Botta-Genoulaz et al. (2005) have carried out a survey of the literature on ERPs that appeared in selected publications during 2003-4. They have classified their results into six categories: implementation of ERP, optimisation of ERP, management through ERP, the ERP as software, ERP for supply chain management, and case studies. They also notice a growing interest on the post-implementation phase of ERP projects, on the customisation of ERPs, on the sociological aspects of the implementation, on the interoperability of ERPs with other systems, and on the return on investment of ERP implementations.

The increased interest in Enterprise Systems (such as ERPs) is also shown by several special journal issues dedicated to the examination of those systems. Two special issues of the Journal of Strategic Information Systems in particular (Howcroft et al., 2004; Wagner et al., 2005) have addressed the contextual influences on the design, implementation, use and evaluation of Enterprise Systems. The Database for Advances in Information Systems has also published two special issues on critical analyses of ERP systems, both at the micro as well as the macro level (Howcroft and Truex, 2001, 2002). In addition, a special issue of the European Journal of Information Systems was also devoted to Enterprise Systems (Themistocleous and Watson, 2005).

Although Botta-Genoulaz et al. (2005) mention the growing interest on post-implementation issues of ERPs, the actual use of such systems as a topic of research is characteristically absent from their survey. Hence we have limited understanding of issues affecting the use of ERPs in organizations and their potential for organizational impact. This is a gap that this research tries to address.

In the following sections, some of the existing literature on ERP systems is examined. The functionality of those systems is first discussed, followed by issues regarding their implementation. As the concept of agency is central to this research, existing literature on ERP systems and agency (human and machine) is also discussed.

2.3.1. Functionality of ERP systems

Although ERP systems were originally designed to be used within an organization, in the last years they have evolved considerably to include or link with external

functionalities such as Customer Relationship Management (CRM), Supply Chain Management (SCM) and e-business (B2B and B2C). Davenport and Brooks (2004) see the future of enterprise systems (such as ERP systems) as having a big role to play in the integration of the whole supply chain, whereas now the emphasis is more on intra-enterprise integration. In this sense, Davenport and Brooks note the following promising areas where enterprise systems can have an impact: new planning functionality, direct connections among firms, RFIDs (Radio Frequency Identifications) and the Electronic Product Code (EPC), and Enterprise Systems and supply chain outsourcing. According to Themistocleous and Watson (2005, p. 107), “it seems appropriate to now think of Enterprise Systems (ES), not as one mega-ERP system, but as a collection of systems, continuously evolving, striving to become the perfectly integrated system, and also constantly challenged to change by the overwhelming need to keep up with technologies and business practices”.

It must be mentioned however, that the examination of ERP systems at the case study companies included only internal operations, and the use of such systems referred only to internal actors, without examining external linkages. With regards to such internal operations, an ERP system enables a company to integrate the data used throughout the entire organization, and to streamline its processes. As Truex and Ngwenyama (2000) mention, “when properly integrated and functional, ERP systems promise to deliver streamlined enterprise-wide business processes, information and data management” (p. 646). There are many companies producing commercially available ERP systems, the most popular of which are SAP, Oracle, PeopleSoft, BAAN, JDEdwards, and so on (there have been some mergers and acquisitions amongst big players in the last years).

With regards to the internal (intra-enterprise) functionality of ERP systems (which was examined in this research), this is comprised of integrated modules that link diverse business functions such as sales, marketing, production, inventory, logistics, finance, accounting and human resources (Davenport, 1998; Laudon and Laudon, 2006; O'Brien, 2004; Sumner, 2005). These modules can be bought individually as standalone, or they can be integrated seamlessly to form a whole software package that spans all or most of organizational processes. Almost all of the companies that install an ERP system have the finance and accounting modules installed, whereas other modules such as human resources and logistics are only adopted by some companies, according to business needs. Figure 1 below indicates the major (intra-enterprise) areas of application of an ERP system.

ERP systems also incorporate elements of the “just-in-time” and “lean production” models (Robinson and Wilson, 2001), in the sense that they seek to facilitate the fastest and most adaptable forms of production, while at the same time committing minimal amounts of labour and capital to the activities of a firm at any time.

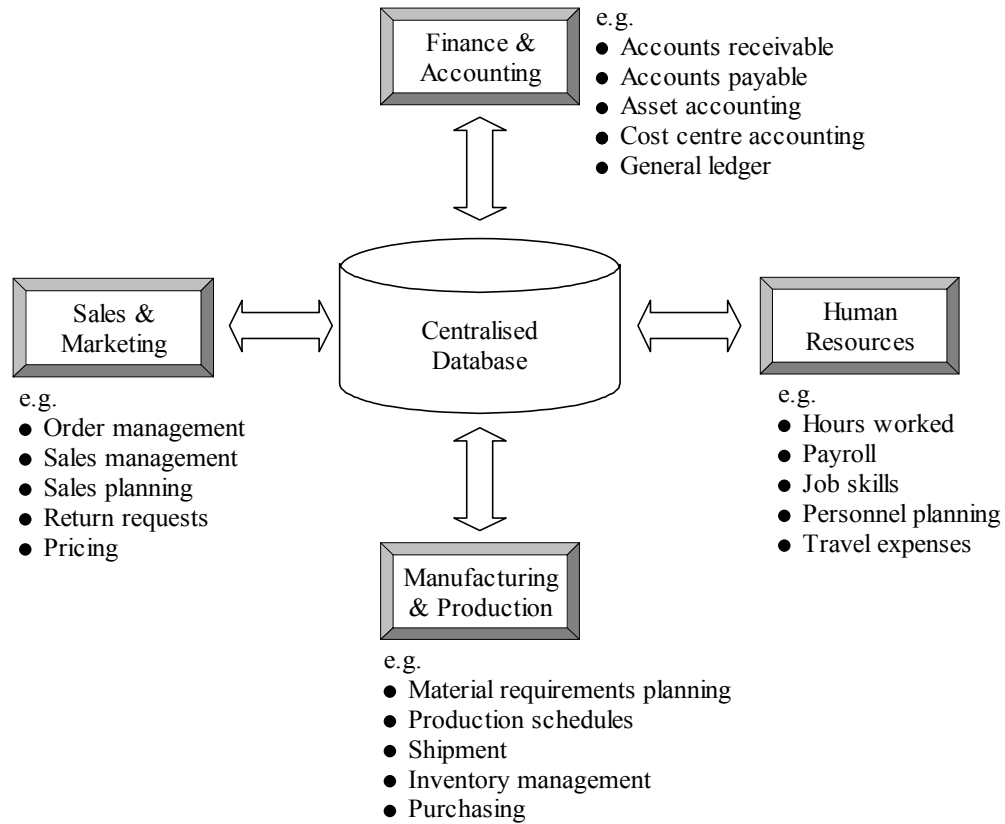


Figure 1: Anatomy of an Enterprise System (Adapted from Laudon and Laudon (2006) and Davenport (1998))

Having described the (intra-enterprise) functionality of ERP systems, the next section concentrates on the implementation of such systems. The literature examined includes the life-cycle of ERP implementations, the Business Process Reengineering (BPR) necessitated by the installation of ERP systems, the success factors associated with the implementation of those systems, as well as the acceptance and resistance of those systems by the user community during or after implementation.

2.3.2. Implementation of ERP systems

2.3.2.1 Life-cycle of ERP implementations

Markus and Tanis (2000) view four phases in the implementation of an ERP system: chartering, project, shakedown, and onward and upward. In the chartering phase, decisions are made regarding the business cases and solution constraints. In

the project phase, the system is set up and end users are starting to use the system. In the shakedown phase, the system is stabilized, used for day-to-day operations, and bugs are eliminated. In the onward and upward phase, the users are supported and the system is maintained, while at the same time benefits from the system are obtained, and extensions are considered.

Other authors have proposed similar life-cycle models of an ERP implementation. For example, Somers, Nelson and Ragowsky (2000) view the following six phases in an ERP implementation project: initiation, adoption, adaptation, acceptance, routinisation, and infusion. Chang and Gable (2000) view three such phases: (1) pre-implementation, involving requirements definition and software selection, (2) implementation, involving modifications to the software, project and change management, and (3) post-implementation, involving roll-out, upgrades, and assessment of benefits.

Based on such life-cycle models of ERP implementation (e.g. Chang and Gable, 2000; Esteves and Pastor, 2001; Markus and Tanis, 2000; Somers et al., 2000), a framework for the ex-ante evaluation of ERP software has been proposed by Stefanou (2001). This framework consists of 4 phases:

1. In the first phase, the business vision is considered as a starting point for the ERP acquisition.
2. In the second phase, the company's business needs, capabilities and constraints in relation to the ERP software are analyzed.
3. In the third phase, the costs and benefits required for the ERP implementation are estimated.
4. In the fourth phase, the issues involved in ERP operation, maintenance and evolution are analyzed.

As installation of an ERP system in a company usually entails Business Process Reengineering to match the processes in the system, the next section addresses this aspect.

2.3.2.2 ERPs and business process reengineering

Although ERP systems offer the potential for big benefits, implementation of an ERP system can cause major change to the business processes of a company (Al-Mashari and Al-Mudimigh, 2003b; Bernroider and Koch, 1999; Davenport, 1998; Rao, 2000b; Schnederjans and Kim, 2003). In the past, companies would choose how they wanted to do business and then choose a software package that would support their processes, often rewriting large portions of the software to ensure a tight fit. With ERP systems however, this sequence is reversed, in the sense that the business must often be modified to fit the system. Although some customization is possible, the system's complexity makes major modifications impracticable. As ERP systems usually offer a generic solution, companies doing business in an

idiosyncratic way may find that their way of doing business is not supported by an ERP. Companies failing to reconcile the technological imperatives of the ERP system with the business needs of the enterprise may therefore fail in successfully installing an ERP system, a process which can be very costly (Holland and Light, 1999; Summer, 1999).

Koch (2001) argues that three features of ERP systems support even radical Business Process Reengineering (BPR): (1) The scope, (2) The configurability, and (3) the integrativeness. With regards to the scope, ERP systems cover a number of departments and business processes within an organization. This in combination with a telecommunications infrastructure enables an ERP system to cover entire networks, which can result in radical BPR. Regarding the configurability of ERP systems, by selecting and implementing particular modules of such systems, the business units that are going to use the system can be selected. Customizing the processes in the ERP system can then support the business processes modelled as part of BPR. Regarding the integrativeness of ERP systems, this stems from sharing one common database and the crosscutting business processes enabled by the software. The horizontal crosscutting facility is then central for realizing BPR. However, as Al-Mashari and Al-Mudimigh (2003b) mention, the benefits that could result from ERP-induced BPR are only possible when there is total commitment, persistence and leadership within an organization.

The next section concentrates on cited success factors in the literature, with regards to the implementation of ERP systems.

2.3.2.3 Implementation of ERPs and success factors

Many authors highlight the importance of an ERP implementation in order to support a company's strategic objectives (e.g. Ash and Burn, 2003; Beard and Sumner, 2004; Davenport, 2000; Huxley and Stewart, 2002; Ke et al., 2003; Nikolopoulos et al., 2003; Somers and Nelson, 2003; Thomas, 2003; Weill and Broadbent, 1998). From a practical perspective however, although ERP systems have been touted by ERP vendors as tools to enhance control over the company's operations, empower employees and streamline business processes, the expected benefits have not been achieved by many organizations. This has prompted research on critical success factors associated with the implementation of an ERP package (e.g. Koch et al., 2000; Markus et al., 2000; Nah et al., 2001; Sarker and Lee, 2003; Summer, 2000).

Willcocks and Sykes (2000) have identified nine core capabilities necessary for a successful ERP implementation, those being (1) IT leadership, (2) business systems thinking, (3) relationship building, (4) architecture planning, (5) technology fixing, (6) informed buying, (7) contract facilitation, (8) contract monitoring, and (9) supplier development.

Similarly, Sarker and Lee (2003) have examined from a social perspective three key enablers for a successful ERP implementation, those being (a) strong and committed leadership, (b) open and honest communication and (c) balanced and empowered implementation team. Their results indicate that although strong and committed leadership is a necessary condition of a successful ERP implementation, the same does not necessarily hold for an open and honest communication and a balanced and empowered implementation team.

In a similar vein, Nah et al. (2001) have identified eleven critical success factors associated with the implementation of ERP systems, those referring to: (1) ERP teamwork and composition, (2) change management program and culture, (3) top management support, (4) business plan and vision, (5) business process reengineering with minimum customization, (6) project management, (7) monitoring and evaluation of performance, (8) effective communication, (9) software development, testing and troubleshooting, (10) use of a project champion, and (11) appropriate business and IT legacy systems.

Lee and Myers (2004) however argue that the implementation and success of an ERP system in an organization also relies a lot on political agendas and actors, as well as strategic shifts over time. Those may cause delays, costs overruns or lack of expected benefits from an ERP implementation, or in the worst case result in its complete failure. By the time the ERP implementation is completed, which can be many years, management, political agendas, actors and strategies may have changed. This would then mean that the ERP system no longer reflects the strategic objectives of the firm and is considered a failure.

As can be seen from the above review, the literature on success factors of ERP implementation projects is varied, although most authors emphasize the importance of management support, communication and skills of project team, effective business and change management plan, and efficient project management. Although many of the above authors seem to imply that the suggested implementation success factors may be used as a yardstick for the determination of success or failure of ERP implementation projects, there may also be other factors influencing the perceived success or failure of such systems during their actual use. The results of this thesis for example indicate that power differentials and the relationship of the users with the department responsible for the ERP system can also influence the way the system is used and its perceived success or failure.

The next section focuses on the acceptance and resistance of ERP systems, which is also a topic relevant to this research, as it may impact the use of the system.

2.3.2.4 Acceptance and resistance of ERPs

There are various reasons for accepting or resisting a particular technology. Managers can resist a technology when balances of power are threatened (Knights and Murray, 1994). Users and departments can resist technology when it works against their interests (Markus, 1983).

According to Hwang (2005) and Lim et al. (2005), a variety of theories such as Diffusion of Innovation Theory (Bradford and Florin, 2003; Fichman and Kemerer, 1999; Plouffe et al., 2001; Rogers, 1995), Theory of Reasoned Action (Ajzen and Fishbein, 1980; Davis et al., 1989; Karahanna et al., 1999) and Theory of Planned Behaviour (Ajzen, 1991; Harrison et al., 1997) have been used to explain user acceptance of new technology. A common thread amongst those theories is that individuals' cognitive perceptions have a big impact on their IT utilisation behaviour.

One of the most popular of such models is in fact the Technology Acceptance Model (TAM). In this model a rational actor uses or refuses to use a new technology on the basis of the two criteria of perceived usefulness and perceived ease of use (Davis, 1989; Davis et al., 1989). The perceived ease of use then has a positive effect on the perceived usefulness of new technology. TAM is in fact one of the most popular models that is used to explain end-user adoption of IT, and has also been used in ERP implementation studies (e.g. Amoako-Gyampah and Salam, 2004; Gefen, 2004; Igbaria and Tan, 1997; Legis et al., 2003). Hwang (2005) has used the Technology Acceptance Model to investigate adoption of enterprise systems (such as ERPs), concluding that an uncertainty avoidance culture and intrinsic motivation of users in an ERP implementation help influence the users' perceived ease of use and usefulness of the system.

Lim et al. (2005) have argued that in order to manage user acceptance of ERP systems, the dissonance between user expectations and managerial policies has to be examined. To this end, Lim et al. have employed the constructs of effort-performance expectancy, performance-outcome instrumentality and outcome-valence as experienced by ERP users, and the managerial actions affecting each construct that may result in users not accepting the system. The three constructs operate sequentially. Expectancy in this case refers to the perception that one's effort will lead to desired performance, instrumentality is the perception that if one does meet the performance expectations he/she will receive an award as compensation, and valence is the perceived value one attaches to those actual rewards. Lim et al. argue that the three constructs together can increase knowledge on the forces that prevent users from using an ERP system to its full potential. If user's anticipations of expectancy, instrumentality and valence are not met in this case, users will resist the system to varying degrees.

Having described existing literature on the implementation of ERP systems, the next section looks into the agency (machine and human) relevant to the use of those systems, which is a topic pertinent to the current research.

2.3.3. ERP use and machine agency

Askenas and Westelius (2000) have proposed to confer an actor status to ERP systems, thereby giving them characteristics of being able to influence the actions within the company, and thus its structure as well. Their purpose was not to give an ERP system “human” characteristics, but rather to pinpoint the socially constructed roles that are attributed to an ERP system (or more generally to an Information System) by its users and other people who are affected by it.

The proposed framework by Askenas and Westelius covers five roles that an ERP (or more generally an Information System) can have in an organization: (a) Bureaucrat (maintaining the structure of the organization), (b) Manipulator (changing or conserving work processes in ways not intended by its users), (c) Administrator (not affecting organizational processes and structure, but used as a means to simplify record keeping and dissemination of data), (d) Consultant (providing users with options and solutions tailored to specific situations), and (e) Dismissed (not used). The actual role of the system may differ depending on the context that it is used, and the perceptions of the people using it. Thus ERP systems are shaped by their surrounding infrastructure, i.e. the people working on them and the relevant organizational structure, as well as other Information Systems interacting with the ERP system. This may happen intentionally or unintentionally. These concepts are also relevant to the current thesis, which looks at contextual factors shaping ERP use, as well as the actual use of the system by its users and its impacts on the organization.

In addition to Askenas and Westelius (2000), Dillard et al. (2005) have used a critical theory perspective to argue that ERPs are a physical manifestation and facilitator of instrumental rationality. The general objective of instrumental rationality is to pay employees as little as possible and distribute as many resources to top level managers and shareholders as possible. Instrumental rationality (and consequently an ERP system) then restricts the formulation and development of ethics, trust, morality and professionalism. ERPs according to Dillard et al. (2005) are an example of the technology’s potential to enhance, and be enhanced by, a dominant ideology as, and through the tangible manifestations of instrumental rationality. This is because, as Dillard et al. argue, ERP design and implementation is based on (implicit) assumptions of property ownership and wealth distribution. On the other hand, as user actions in the system are inherently recorded, tracked and analyzed, individual autonomy is lost. Ultimately, an ERP system dehumanizes actors affected by the use of the system, by expressing them in purely technical and ostensibly ethically neutral terms. These ostensibly ethically neutral terms arise because of the legitimacy attributed to the instrumentally rational models and procedures that are embedded in the system.

Dillard et al. seem to be quite biased towards the supremacy of the ERP system as an actor, leaving little or no room for human agents (the users) to exercise initiative. I would tend to distance myself from such a viewpoint however, by examining in this thesis to what degree users can use the system according to their own perceptions, instead of accepting that ERPs have to be seen as “dehumanizing” in all cases. The role of human actors (e.g. users) in the use of an ERP system is actually discussed in relevant literature presented in the next section.

2.3.4. ERP use and human agency

One important strand of ERP research which is also relevant to the current thesis is the linkage of ERP use with the agency of humans. Kallinikos (2004) for example argues that ERP systems help shape human agency and institute patterns of action and communication in organizations. They accomplish this by delineating the paths along which human agency should take place. This is afforded by the dissection of organizational activities in discreet terms, and the provision of the procedural sequences for the execution of particular tasks. In this sense, ERP systems are mostly concerned with streamlining, control and standardisation of organizational operations. In so doing, ERP systems enable the construction of accountable and governable patterns of behaviour in organizations.

Similarly, Boudreau and Robey (2005) have pointed to the fact that when looking at organizational change arising from the use of IT, an agency perspective may mean limited possibilities for radical IT-induced change. An agency perspective of IT in this case takes the position that IT is socially constructed and open to a variety of social meanings and potential uses. Boudreau and Robey (2005) argue that certain technologies allow for a greater degree of human agency and others to a lesser degree. Their views agree with those of Orlikowski (2000), who acknowledges that while users can and do use technologies as they were designed, they also can and do circumvent the intended uses of technologies, either by ignoring certain properties, working around them, or inventing new ones.

The research by Boudreau and Robey (2005) looked at ERP systems, which are seen as inflexible software packages constraining user-inspired action (human agency). Their results, however, indicate that although ERP systems are seen as rigid control mechanisms, there is still scope for human agency to take place within such systems, contradicting Kallinikos (2004). The research by Boudreau and Robey indicated that technical system constraints on human agency can be overcome through a process of initial inertia (rejection of the system), improvised learning as a result of pressure to use the system, and finally reinvention of usages of the system, to match their own previous experiences and background.

More comprehensively, recognizing the importance of the social and material aspects of Enterprise Systems (such as ERPs), Howcroft et al. (2004) argue for recognition that an Enterprise System is a social and physical artefact. Some of the design choices of such a system are based on technical considerations, but many are also based on social considerations reflecting assumptions about the environments where the system is to be used. Once adopted by users, however, those assumptions and preferences may change as a result of the emergent and unexpected consequences of the use of the system. Hence users will shape the technology to their own practices. Those user preferences in turn arise from a particular organizational context. Once adopted, an Enterprise System may then influence in intended and unintended ways the structure and culture of the organization.

Taking the above literature into consideration, this study examines to what degree human agency can take place in an ERP system, and what the impacts on organizational control and drift are. By doing so, attention is also paid to the material properties of the ERP system (Orlikowski and Iacono, 2001), as well as the contextual factors (Howcroft et al., 2004; Wagner et al., 2005) impacting ERP use. Closely related to the concept of human agency in the context of IT use is also that of interpretive versus *interpretative* flexibility, the distinction of which is discussed below.

2.3.4.1 Interpretive vs *interpretative* flexibility

According to Cadili and Whitley (2005), interpretive flexibility claims a significant role for the specifics of technology, while *interpretative* flexibility does not include any consideration of the material features of the technology. In this thesis, the notion of “interpretive” flexibility is followed when discussing human agency. Interpretive flexibility is described by Orlikowski (1992) as an attribute of the relationship between humans and technology. As such, interpretive flexibility is influenced by the characteristics of the material artefact (e.g. hardware and software), the characteristics of the human agents using it (e.g. experience, motivation), and the characteristics of the context where the technology is used (e.g. social relations, resource allocations, task assignments). I use the concept of “interpretive” as opposed to “*interpretative*” flexibility in IT use in this thesis, as I assign an important role for the part of the machine (ERP) agency in shaping the use of technology, while at the same time recognising that situated user actions (Suchman, 1987) are important in influencing organizational control and drift.

Having discussed relevant literature on ERP systems, the next section presents literature on organizational control, which is a central theme of this thesis.

2.4. Organizational Control

2.4.1. Classifications of organizational control

Ouchi (1977) distinguishes between two simple types of control, behaviour control and output control. Behaviour control deals with the process used to produce an outcome, whereas output control deals with the actual outcome of that process. Ouchi argues that the more un-analyzable and non-routine the task is, the less appropriate behaviour control is, and consequently the more important output control should be. On the other hand, the more complete the set of formalized procedures and rules to specify behaviour, the less the need for output control.

Within an organization, the controlling of employee actions (behaviour control) can be conceptually linked to the notion of Bentham's Panopticon, used by Foucault (1977) to illustrate the idea of a tool of perceived constant surveillance. Bentham originally introduced the notion of the Panopticon in the late eighteenth century as a type of prison building, where the prisoners are arranged in cells in a circular fashion. In the level above the cells, there is an arrangement of space, such that the guards can watch the prisoners at any time, but the prisoners cannot see if they are being watched or not. This imposes a sort of psychological pressure on the prisoners, inhibiting them from engaging in non-acceptable behaviour, since this may be monitored by the guards. Foucault (1977) extended the notion of the Panopticon, to use it as a metaphor for the issue of power and control. In this case the guards of the prison exert control over the prisoners, even when not being present to watch over them. The power of the guards over the prisoners derives from the fact that they can impose the required behaviour to the prisoners, by making them think they are omni presently watching them.

For a more comprehensive classification of controls, Orlikowski (1991) distinguishes between two broad types of control: internal and external.

- In internal control, Orlikowski further distinguishes between personal and systemic control:
 - Personal control involves a dyadic relationship where a person with authority supervises the work of a subordinate.
 - Systemic control is more transparent and indirect, and resides in three organizational properties – technology, social structure and culture:
 - In control through technology, control is facilitated with the use of technical systems.
 - In control through social structure, control is through the company's procedures and rules, job descriptions, policies, career ladders and incentive schemes.

- In control through culture, shared norms and values shape behaviour, order perception and influence attitudes.
- Finally in external control, companies assign a part of their training and indoctrination to outside organizations.

According to Orlikowski (1991), such control mechanisms tend to be both enabling and constraining – enabling in the sense that they mediate the coordination of individual actions and constraining in the sense that they restrict the outcome of individual actions.

All of the above forms of control described by Orlikowski can coexist in an organization, they are not mutually exclusive. However, if one form of control is waning, it is common for other forms of control to increase, to substitute for the loss of one form of control. In any combination of controls, however, power relations are reciprocal; hence power relations are never totally dominating. This is because controlled individuals have the option to act in ways to change a particular form of control. This is referred to as the “dialectic of control” (Giddens, 1979, 1984), whereby subordinates can influence the activities of their superiors, by using some of the resources that they have available to use (Giddens, 1984, p. 16).

The next section discusses organizational control as enabled by Information Systems (IS). This falls under Orlikowski’s (1991) classification of “systemic” control, and in particular control through technology.

2.4.2. Organizational control and IS

2.4.2.1 Overview

Although Information Systems can be computerised (IT-based) or not, the assumption in this section and the sections that follow is that Information Systems are computer-based, so that organizational Information Systems are supported by the use of IT. This section presents an overview of the issue of organizational control and IS, while the following sections present the benefits of organizational control through IT, as well as comparing IT-enabled organizational control with empowerment.

IT in an organizational context in fact has been often used to promote organizational control. Bloomfield and Coombs (1992) mention that with the advent of the first computers the expectation was that they would centralise organizational power, with the information processing capacity of computers seen as an extension of managerial control. Finnegan and Longaigh (2002) have confirmed that IT can facilitate the centralisation of organizational control. The

headquarters in this case can use IT (which can range from simple e-mail utilities to complex systems like ERPs) to modify operational and decision making environments within subsidiaries in order to promote a more direct day-to-day monitoring by the headquarters of the activities of the subsidiaries. However, Bloomfield and Coombs (1992) also point to the paradox that although the use of IT to monitor standards and output leads to more centralisation and control, the displacement of decision-making to peripheral locations creates a form of decentralisation. There are also studies which are concerned with IT-enabled empowerment (e.g. Clement, 1994; Duane and Finnegan, 2003; Elmes et al., 2005; Malone, 1997; Panteli, 2001; Panteli and Corbett, 2004; Psoinos et al., 2000; Psoinos and Smithson, 1996) as opposed to IT-enabled control, and which are discussed further below.

With regards to the organizational functions that IT enables to control, Granlund and Mouritsen (2003) mention that from the early days of IT, accounting and information technology were closely related, although organizational IT later widened its areas of application, e.g. in marketing, production, purchasing and distribution. As has been discussed in section 2.3.1, an ERP system is seen as a response to integrate all or most of these areas in an organization, in order to provide better control over the relevant data and processes

O'Donnell and Rechtman (2005) view general IT controls as the access to programs and data, data centre operations, program development and changes, IT disaster recovery plans, and the segregation of duties of Information Systems department personnel. In more detail, computerised application controls include the controls involving the processing and storing of business transactions, ensuring their completeness, accuracy, authorisation and validity. Such controls can include application security, input controls, rejected-transaction controls, transaction-processing controls, and output controls. Such types of controls can be both allocative (control over objects, such as data) and authoritative (control over persons) (Giddens, 1979). Allocative control then comes because of the ability of Information Technologies to store, retrieve and transmit information, and authoritative control comes from imposing means of coordinated working (Sewell, 1998; Zuboff, 1988). Many of these types of control (such as access controls or monitoring of employee activities) were also observed in the examination of the case study companies, as will be discussed and analyzed in chapters 4 to 6.

As information is seen to be at the core of organizational control (Finnegan and Longaigh, 2002) the importance of IS (usually IT-based) becomes evident. More generally, control through technology (such as computer-based IS) is closely linked to managerial control. Simons (1995b) for example mentions that management control systems are essentially information-based systems. As Lawler and Rhode (1976) illustrate, control systems (and therefore Information Systems) change the power relationships in organizations (and are also seen as threats to the satisfaction of many company needs) for the following reasons:

- Control systems can automate expertise, thereby taking away power from individuals, as their own expertise becomes redundant
- Control systems can create new experts and give them power
- Control systems have the potential to measure individual performance more accurately and completely
- Control systems can change the social structure of an organization
- Control systems can reduce opportunities for intrinsic job satisfaction

Relevant to the above discussion, the findings from this thesis indicate that companies installed an ERP system to promote organizational control to a lesser or greater degree. The findings of Lawler and Rhode (1976) however, more than three decades ago, were also found to be relevant in the case of the ERP systems of today, where automation of routines, power differentials, enablement of performance measurement and sometimes reduced job satisfaction were observed in the case study companies. From a managerial perspective however, there are also many benefits of implementing organizational control through IT, which are discussed next.

2.4.2.2 Benefits of organizational control through IT

For managers of a company, IT advances the three traditional purposes of control systems, which are to use resources more effectively, align disparate parts of the organization with the company's goals, and use data for strategic and operating decisions (Bruns Jr. and McFarlan, 1987). Bruns Jr. and McFarlan in fact mention several benefits that a company can obtain when it uses IT to support its control processes. These benefits are achieved by either consolidating, centralising or decentralising operational and strategic information:

- Consolidating data: Managers can consolidate data to produce reports, in essence producing new data that can help find solutions to problems or explore opportunities.
- Centralising data: Information from remote offices can be collected and analyzed centrally, in order to track performance and identify potential problems.
- Decentralising data: By giving people the information to do their job right companies can use IT to tighter corporate control.

Bruns Jr. and McFarlan give some examples of the control systems enabled by IT. Although these examples covered IT systems two decades ago, they are also applicable today, albeit in a more sophisticated fashion. In fact as the results from this thesis and most of the literature on ERP systems indicate (as has been discussed in section 2.3.1 above), an ERP system itself aims amongst other things to integrate the areas proposed by Bruns Jr. and McFarlan (1987) where IT can promote organizational control:

- Meaningful budgets: IT can automate the budget creation process by automatically carrying out calculations.
- Adaptations to change: IT can be used for compliance e.g. to regulatory or other environmental requirements.
- Solutions for production: Monitoring systems can track productivity and errors, allowing to remedy situations before they become critical.
- Facts to make the sale: By holding customer information, sales can be more efficiently target to match customer requirements.
- Tracking inventory and sales: Companies can trace orders, monitor inventories, and alert manufacturing and suppliers to upcoming requirements.
- Effective incentive systems: For example, salespeople can see how far they are from achieving their required sales and commissions.

In addition to control, although the concept of empowerment is not central to this thesis, it is many times contrasted to or compared with organizational control (Ball and Wilson, 2000; Bloomfield and McLean, 1996; Conger and Kanungo, 1988; Dobbs, 1993; Doolin, 1999; Duane and Finnegan, 2003; Randolph, 1995, 2000; Sia et al., 2002; Simons, 1995a, 1995b). As such, the next section discusses organizational control and empowerment enabled by the use of Information Technologies.

2.4.2.3 Organizational control and empowerment through IT

The paradox addressed by many scholars examining Information Systems and organizational control (e.g. Coombs et al., 1992; Duane and Finnegan, 2003; Malone, 1997; Tang et al., 2000) is that while Information Systems can empower employees with increased decision-making capabilities, at the same time they can serve to increase control over them (e.g. Bloomfield and Coombs, 1992; Bloomfield et al., 1994; Orlikowski, 1991). Zuboff (1988) also addresses this paradox when posing the question “Are we all going to be working for a smart machine, or will we have smart people around the machine?” (p. 285). In the first part of the question she identifies increased control and automation through IT, while in the second part she identifies empowerment of people through IT.

Although the issues relating to empowerment through IT are not new, the number of studies carried out in this area is quite limited. Doolin (1999) for example argues that “...Information Systems associated with attempts to increase management control of organizational participants are also capable of empowering those intended to be controlled by making available a legitimate arena for action and discussion with the organization” (p. 289). According to Bloomfield and McLean (1996) however, although the equation of IT with power is sometimes taken for

granted, it is questionable whether the exercise of that power is ultimately enslaving or emancipating.

Tang et al. (2000) have proposed a matrix to specify the impact of the context of IT-enabled change and the tasks involved on panoptic control and empowerment, as the table below shows.

Table 1: Impact of context of IT-enabled change and nature of task on organizational control and empowerment (adapted from Tang et al. (2000))

		Nature of Task	
		Structured Task	Unstructured Task
Context of IT-Enabled change	Automational	<p>Quadrant 1</p> <ul style="list-style-type: none"> • Increase in panoptic control • No change in empowerment 	<p>Quadrant 2</p> <ul style="list-style-type: none"> • Limited increase in panoptic control • No change in empowerment
	Transformational	<p>Quadrant 3</p> <ul style="list-style-type: none"> • Large increase in panoptic control • Increase in empowerment 	<p>Quadrant 4</p> <ul style="list-style-type: none"> • Increase in panoptic control • Increase in empowerment

Tang et al. (2000) argue that when the context of IT-enabled change is transformational, then this acts as a catalyst for empowerment to take place. On the other hand, when the context of IT-enabled change is automational, much of what was done previously is now recast within IT.

According to Tang et al., and relevant to this thesis, an ERP system is a structured system (another example of a structured system is a computerized transactional system). On the other hand, software like a CASE (Computer Aided Software Engineering) tool is an unstructured system, in the sense that it does not force users into pre-specified patterns of behaviour. As a structured system therefore, ERPs fall into either Quadrant 1 or Quadrant 3, depending on whether they simply automate existing processes or more radically transform them to the best practices embedded in the ERP system. In both cases the ERP system allows for an increase in panoptic control (more in the transformational case), while employees may also be empowered with carrying out new tasks when the ERP system transforms their daily routines.

Although not central to this thesis, the concept of empowerment is also used as a sensitizing device for the analysis of the case study data. Although this section has concentrated on its link with IT and control, the concept of empowerment as a

sensitizing device is also discussed and defined in section 2.8.6. Having presented the various classifications of control and its link with Information Systems in the previous sections however, the next section discusses the concept of drift.

2.5. Technology Drift

As existing research has overlooked the concept of drift (van Fenema and van Baalen, 2005), this is a gap that this study tries to address. The concept of technology drift was in fact originally developed by Winner (1977) when discussing technological determinism. Ciborra (2002) has also looked into the issue of drift during the implementation of technological systems. He defines drift as the processes of matching between situated human interventions of use and open technology. Technology drifting can be the result of passive resistance, learning-by-doing, sabotage, radical shifts in conditions, or plain serendipity. It can result from hacks, twists, or short cuts taken in the system.

Ciborra and Hanseth (2000, p. 4) argue that technological drifting is “like a ship that starts drifting – means that an organization encounters unexpected circumstances that show the incompleteness and possible failure of an initial technological design without organizations having yet feasible alternatives”. Van Fenema and van Baalen (2005) argue that control (at least in the context of technology implementation) can be viewed as the counter-concept of drift. The purpose of control is then to prevent technologies from drifting and to reduce the risks associated with drifting. Drifting in this case can be seen as “not an invariable and independent outcome of the adoption and implementation of new technologies, but primarily as a gap between the intended and unintended consequences” (p. 9).

In addition, Ciborra (2002, p. 84) argues that “one of the main characteristics of ICT as a modern phenomenon in organizations and society is that it is *à la derive*: the information infrastructure might have enhancing effects, but it also drifts”. Drifting then according to Ciborra describes a (big or small) shift in the envisaged role and use of technology, compared with the planned objectives and requirements. Drifting is not however paramount to alternative plans and goals, or different strategies. Drift is not about plans, even alternative ones. Drift in this case according to Ciborra chases plans away, while at the same time being complementary to them. However, Ciborra views drift as not necessarily a negative phenomenon per se, in the sense that it can occur for both applications that are considered as successes and those that are not.

Ciborra (2002) characteristically recognizes the interplay between human and machine agencies in causing (technological) drift: “Matching visible and invisible affordances with tactics leads to new uses: the re-invention of artefacts and technologies and their shifting away from the pre-assigned uses. The result is drifting. Drift is thus the outcome of the match between two agents: technology-possessing affordances; and humans in their various roles of sponsor, user, and designer” (p. 91). This perspective is also relevant in this thesis, which assigns an important role in the interplay between human and machine agencies in propagating drift (or control) through the use of an ERP system.

Having described the concepts of organizational control and technology drift, the next section examines how those two concepts were addressed in ERP literature in particular.

2.6. *ERPs, Control and Drift*

With regards to the issue of control from ERP systems, Hanseth et al. (2001) argue that ERP systems, with their emphasis on integrating business processes, streamlining and standardization, are an ideal control technology. In that sense, the integrated approach to control within an ERP model allows for its automation, in a way that replaces traditional forms of hierarchical supervision (Robinson and Wilson, 2001).

As Hanseth et al. (2001) however mention, implementing an ERP system over a global organization in order to enhance control may as well have the opposite effect, i.e. reduce control and cause drift. Although this may come as a surprise when one looks at this from the point of view of IT being a control technology, the fact that more control can lead to more risk (and potentially drift) is explained with the ubiquitous nature of side effects. The more integrated from a technology and process point of view the organization then becomes, the faster and farther side effects have an impact, and the bigger their consequences. Those can be so overwhelming that Hanseth et al. liken ERP installations in global organizations to that of a juggernaut, i.e. a runaway engine of huge power, which humans collectively can drive to some extent, but which can also get out of control in unforeseeable directions.

Sia et al. (2002) have also examined whether the introduction of an ERP system in a company entails tighter management control or empowerment of employees. Management control through an ERP system was equalled by Sia et al. with the panoptic (Foucault, 1977) features of those systems. Those features were summarized in three dimensions:

- Comprehensive system tracking capability, which was enabled by the infrastructure of ERP systems that allowed the gathering, tracking, reporting and analysis of the behaviour of workers.
- Enhanced visibility to management, which was enabled by the “best practice” management tools embedded in ERPs, e.g. activity-based costing, profitability analysis, and profit centre accounting.
- Enhanced visibility to peers, which was enabled by the process-oriented (workflow) design of ERPs, creating interdependencies between functional tasks. Visibility to peers was also enhanced by the use of a single shared database in ERPs, resulting in data interdependencies between peer workers.

Sia et al. have concluded that the impacts of imposing panoptic control and empowering users are usually manifested at the business process level. However, given the bureaucratic structures in many organizations, Sia et al. argue that ERPs would mostly tend to be biased toward greater panoptic control, unless there are clear management intentions to break away from existing power structures.

In addition, Elmes et al. (2005) have identified two seemingly contradictory theoretical concepts in Enterprise Systems (such as ERPs): reflective conformity and panoptic empowerment. Reflective conformity refers to the way that the integrated nature of the Enterprise System leads to greater discipline of employees, while at the same time requiring them to be reflective in order to achieve the required organizational benefits from the Enterprise System. Panoptic empowerment then describes the greater visibility of information, which is provided by the shared database of the Enterprise System. This can empower employees to do their work more effectively and efficiently, but at the same time makes their work in the system more visible to others, who can then more easily exercise control over them.

Elmes et al. (2005) argue that an Enterprise System (ES) differs in three ways from the ideal panopticon, as proposed by Foucault (1977):

- The mechanism of observation in an ES is less visible, as it is there mainly for facilitating work process, and not for constant observation.
- While all user actions are recorded in the system, users may choose not to enter some relevant information.
- An ideal panopticon provides visibility one-way and not horizontally (only observers have visibility, but the observed cannot see each other). In an ES however, everyone can see everything in the shared database, with the appropriate access profiles.

Dechow and Mouritsen (2005) have also looked at control from a functional area perspective within an ERP system. They observed that the ERP distinguished between an accounting structure and a logistics structure, with the latter being more flexible than the former. Because of this, the system could be used to explore alternatives to financial controls based more on the logistics structure's non-financial data. As a result, a trade-off would have to take place between traditional management control based on accounting numbers, and management control based on operational non-financial data.

In addition, Dechow and Mouritsen (2005) argue that ERP systems impose on users to spend great efforts towards solving problems in the system, and users may respond by either working with the ERP system or trying to circumvent it. They also disagree with Hanseth et al. (2001) that ERP systems simply make firms drift, as those systems rarely leave things open ended. This disagreement in the literature (Dechow and Mouritsen, 2005; Hanseth et al., 2001) whether ERP systems cause firms to drift or not is also an issue that is examined in this study, as has already been mentioned.

In particular regarding the issue of drift, van Fenema and van Baalen (2005) have looked into strategies for dealing with drift during the implementation of ERP systems. They distinguish between three such strategies, from which they argue the

third strategy (drift containment) is the most realistic in ERP implementation projects:

- Control strategy aims at eliminating drifting and risk.
- Incremental strategy considers drifting to be a normal part of technology implementations. In this case “bricolage” is used to adapt technology to its context.
- Drift containment recognizes the inevitable drifting in technology implementations and the fact that drifting may even contribute to the stabilisation of technology. The question is then how to balance control and drift and use drift as a source of stabilisation of technology projects.

Although the above studies looked (amongst others) at either the issue of control *or* drift (but not both at the same time), Nandhakumar et al. (2005) have looked into the contextual forces of an ERP implementation, and how those influence control and drift during the implementation process. These contextual forces were interrelated, and referred to the affordance of the technology, as well as the social structure, practices and norms, either within the organization or external. The analysis by Nandhakumar et al. (2005) was based on examining managers’ intentions, the power and cultural context within the organization, as well as the affordances of the technology.

Control was seen by Nandhakumar et al. to be an outcome of managerial intentions regarding the trajectory of implementation of the ERP system. This depended on both system affordances and social structure. (Technological) drift was then seen by Nandhakumar et al. (2005) to occur from the “organizational members’ planned and unplanned actions in response to both previous technology and organizational properties they have enacted in the past” (p. 239). Unintended consequences of the implementation would then mean that the technology would drift from the planned implementation outcomes. Control and drift during the implementation of the ERP system in this case were interrelated, and would be operating in continuous cycles, in response to contextual forces shaping the actual implementation of the ERP system.

Although Nandhakumar et al. directly acknowledge the influence of users in accepting or rejecting the ERP system, their study mainly examined managerial as opposed to user intentions, and in the implementation, as opposed to the use stage of an ERP system. This thesis therefore complements the viewpoint by Nandhakumar et al. by arguing that the way users use the system according to the affordances of the technology also has a large part to play on impacting control and drift within an organization.

From the above discussion and presentation of the literature, the gap that this thesis tries to address can be identified, which is described next.

2.7. Knowledge Gap

2.7.1. ERP use, control and drift

Although early research on ERP systems focused more on the processes of ERP evaluation, critical success factors for successful ERP implementation and Business Process Reengineering issues, those topics seem to have been exhausted as many organizations have already had an ERP system installed for a number of years. As such, there is a need to focus more on the lessons that could be learned from the actual use of such systems, once they have been deployed for a number of years in organizations.

Regarding the issue of control, although control in a general Information Systems setting has been examined to a large extent (e.g. Ball and Wilson, 2000; Bloomfield and Coombs, 1992; Bloomfield et al., 1994; Bruns Jr. and McFarlan, 1987; Coombs et al., 1992; Duane and Finnegan, 2003; Finnegan and Longaigh, 2002; Lawler and Rhode, 1976; Malone, 1997; Mansell, 1994; Orlikowski, 1991; Simons, 1995a; Tang et al., 2000), the number of studies in ERP systems in particular is still quite limited (e.g. Dechow and Mouritsen, 2005; Elmes et al., 2005; Hanseth et al., 2001; Sia et al., 2002). As has been mentioned, what distinguishes ERP systems from other Information Systems is their scale, complexity, and potential for organizational impact (Laudon and Laudon, 2006; O'Brien, 2004). Because of this, ERP systems deserve greater attention with regards to the issue of organizational control and how it both affects and is affected by the use of the system (according to the research questions presented in section 1.4).

With regards to the issue of drift from ERP use in particular, there are not any relevant studies. Although some studies in ERPs (e.g. Boudreau and Robey, 2005; Cadili and Whitley, 2005; Hanseth et al., 2001; Soh et al., 2000) have examined the use of ERP systems by users, this was not linked to the way it causes organizations to drift.

Hanseth et al. (2001) for example fail to account for the role of users in causing drift by the use of an ERP system, but rather only look at the ERP system itself as drifting. As such, Hanseth et al. implicitly assume that the machine agency of the ERP system is the sole (or the main) responsible for the drift that may be caused by the installation of an ERP system in an organization. However, users when using the ERP system may assign meanings to its functionality and potentially interpret its workings in their own ways (interpretive flexibility of users). By doing so, users may overcome the intended uses of the system and cause drift by doing so, which is an aspect that this study also tries to addresses.

In addition, drift in an ERP setting has only been examined in the implementation stage (e.g. Nandhakumar et al., 2005; van Fenema and van Baalen, 2005), without looking at drift during the actual use of the system. As such, this thesis offers an important dimension in accounting for the way that use of an ERP system is affected by and affects organizational control and drift (as per the research questions in section 1.4). There is also disagreement in the literature (e.g. Dechow and Mouritsen, 2005; Hanseth et al., 2001) as to the degree that ERP systems cause organizations to drift, therefore this is an important aspect that this thesis also examines.

The next section describes the motivation for examining the use of ERP systems from a conceptual point of view.

2.7.2. Conceptualisation of ERP use

As has been mentioned above, the impact of ERP use on organizational control and drift has largely been ignored in the literature. From a theoretical point of view, relevant concepts to explain the use of ERP systems have also not been looked at in the literature. This is also a gap that this thesis tries to address.

This is quite important, as current research on ERP systems tends to move away from initial implementation concerns, and looking more into the impact of ERP systems, post-implementation. Relevant conceptualisations on ERP use can therefore aid in better understanding the impact of the use of such systems on organizations. This thesis in particular examines ERP use from the viewpoint of human (user) and machine (ERP system) agencies, which interact with each other.

As far as the machine agency is concerned, the literature is again split with regards to the degree of flexibility offered by ERP systems. For example, Dillard et al. (2005) and Kallinikos (2004) both take a strong view that there is little scope for human agency taking its own course in ERP systems, due to the rigid structures of such systems. On the other hand, while Boudreau and Robey (2005) also recognize the rigidity of such systems, they also leave some space for human agency to take place in those systems, in the form of ignoring certain system properties, working around them, or inventing new ones. Howcroft et al. (2004) also recognize that users can shape technology to their own practices, assumptions and preferences, which also depend on the organizational context where the technology is used. This thesis therefore tries to conceptualise ERP use, according to contextual factors influencing its use, and the impact of the actual use of the system on organizational control and drift.

The conceptualisation of ERP use developed in this thesis is sensitive to some concepts which are presented in the next section.

2.8. Sensitizing Devices

In interpretive studies such as the current one, the use of theory is “more as a ‘sensitizing device’ to view the world in a certain way” (Klein and Myers, 1999, p. 75). In this sense, this thesis mainly draws on two theoretical concepts: (1) the human and machine agency and their interrelationship (Rose and Jones, 2005; Rose and Truex, 2000), and to a lesser extent (2) the disembedding and (re)embedding (Giddens, 1990) of human actions. In addition, alongside those two concepts, the concepts of control and drift and relevant literature presented in the previous chapter also serve as sensitizing devices (Walsham, 1993), guiding the analyses in chapters 4 and 5.

The concept of human and machine agencies is central to the use of the ERP system, and refers to the actions that the system affords to its users (machine agency), and the actions that users actually take in the system (human agency). There is then interplay between the respective human and machine actions. The concept of the embedding and disembedding of *human* actions refers to the way that human actions in one part of the system affect actions of other users in other parts of the system. Both concepts of human/machine agency and embedding/disembedding can help explain how control is implemented and espoused, and drift is propagated through the use of an ERP system.

The two theoretical concepts of human/machine agency and embedding/disembedding were identified by a review of the relevant literature, particularly the works of Rose and Jones (2005), Rose and Truex (2000) and Giddens (1990). These concepts, and in particular human and machine agencies, were deemed to be important in conceptualising ERP use, and were examined and revised with the case study data as the study progressed, to further assess their applicability and suitability as a framework for the discussion of the research data. These concepts were developed bottom-up from the data collected from the case study companies, instead of forcing the data into pre-defined categories. These theoretical concepts together with other themes emerging from the data were then used to develop a framework to explain ERP use and its organizational consequences, as will be discussed in section 6.2.

The interplay between human and machine agencies in particular, and the disembedding and reembedding of human actions to a lesser extent, were deemed to be important in addressing the research questions presented in section 1.4. In particular, the way that human and machine agencies interact with each other and the way that human agency takes place in ERP systems (through the embedding and disembedding of human actions) were seen to be useful concepts in explaining how control is espoused and drift is propagated from ERP use.

The concepts of human/machine agencies and embedding/disembedding that are used to sensitize the analyses and discussion (in chapters 4 and 5) are described in the following sections, together with a summary of the concepts of control and drift which were presented in the previous chapter in sections 2.4 and 2.5 respectively. In addition, literature from the previous chapter that is used to sensitize the examination of the case study companies is also summarized.

2.8.1. Human and machine agency

Giddens (1984, p. 139) defines agency as the “capability to make a difference, that is to exercise some sort of power”. In other words, agency is synonymous to the carrying (or intentionally not carrying) out of an action.

With regards to actions in an Information Systems setting, Rose et al. (2003) have pointed out an issue central to IS research, which is the relationship between the social and technical aspects of IS. This is the problem of ‘agency’, i.e. if according to Giddens (1984) agency is the “capability to make a difference”, then how do social systems act upon technology, and vice versa? In studies of the role of technology in organizations, the two extreme poles (social determinism (Bijker et al., 1999; MacKenzie and Wajcman, 1999) and technology determinism (Smith and Marx, 1994; Winner, 1977)) offer a simple answer to the problem of agency. For the social deterministic position, agency lies in humans, whereas for the technology deterministic position, agency lies in technology. Actor Network Theory (Callon, 1991; Cordella and Shaikh, 2003; Latour, 1999; Monteiro, 2000; Walsham, 1997) has tried to bridge the two opposing camps by not distinguishing between human and material actors. In addition from a social viewpoint, in the Structuration Theory by Giddens (1984) agency is synonymous with human actors, that are engaged in shaping and being shaped by the structure of social systems. Technical artefacts however in Structuration Theory are simply ‘allocative resources’ used by human actors.

Both Structuration Theory and Actor Network Theory have their shortcomings. The shortcomings of Structuration Theory include the inefficient handling of the material aspect of technology (Jones, 1999b), the lack of taking into account the specifics of IT (Monteiro and Hanseth, 1996), and its questionable use in empirical studies (Gregson, 1989) apart from being seen purely as a sensitizing device (Giddens, 1989). Actor Network Theory on the other hand implicitly adopts a positivistic stance (Cordella and Shaikh, 2003), which may not be appropriate in the study of social settings. This is also confirmed by Monteiro & Hanseth (1996), who argue that ANT cannot deal with institutions in the social aspect of them, where they are shaped and at the same time shape actions.

Rose et al. (2003) have therefore called for an updated model to explain agency, due to the shortcomings of both those theories to satisfactorily explain agency, as well as the apparent difficulties in combining the two approaches. This model is presented by Rose and Jones (2004), where the distinction is made between human agency and machine agency, but where the two are also interwoven and affect each other. For them, humans and machines both exhibit agency, in the sense of performing actions that have consequences, but these two forms of agency are not equivalent. Human agents have forms of awareness and purposes (intentionality), which machines do not. Rose and Jones term their model the “double dance of agency”, which incorporates features from both Structuration Theory and Actor-Network Theory. They argue that their model may be well suited in the study of the implementation of large organizational systems (such as ERPs, which this study examines).

Jones (1999a) points to the emergent nature of the dialectic of resistance and accommodation between the material and human agency. This tends to be reinforced by the doubling of the interaction in technological systems, as human agents try to marshal material agency to direct the actions of other human agents, or to channel material agency to shape the actions of other human agents. The original conceptualisation of the “mangle” of human and material agency, derives from Pickering (1993), who defines it as “emergent human and material agency reciprocally engaged by means of a dialectic of resistance and accommodation” (p. 559). Pickering’s position is close to that of Actor-Network Theory (ANT), in the sense that in ANT equal weighting is given to human and non-human agents. Pickering argues that material agency is temporally emergent in practice, while human agency is characterized by intentionality. He also distinguishes between constraint and resistance: while constraint is a human characteristic, resistance (and also accommodation) exists in the interplay of human and material agency. However, I would personally tend to disagree with this position, as (technical) constraints can also be imposed by physical properties of things, therefore constraints can be a material characteristic as well.

Rose and Truex (2000) have also criticised the material agency model by Jones (1999a) in the sense that this model which incorporates human and material agency (the double mangle model) is less developed than those of Structuration Theory or Actor Network Theory, and therefore the position of the analyst/practitioner who wishes to use this model is weakened. In addition, the double mangle model is wholly compatible neither with structuration theory nor with actor network theory. Rose and Truex (2000) have therefore proposed to give alternative understandings of machine agency, which leverage the analytical power of existing theory. Machine agency in this case is viewed as perceived autonomy. This conceptualisation is compatible both with structuration theory and actor network theory, and therefore leaves the analyst / practitioner in a stronger position. Rose and Truex argue that machine agency appears strong when machines are viewed as black boxes in their use, but strong agency disappears when the development stage

of the machine is considered historically. Machine agency is then the emergent property of the development process and becomes embedded in the completed machine. Machine agency as autonomy is then not integral to the machine itself, but strongly depends on the way that it is perceived.

Although the view of Rose and Truex of machine agency as perceived autonomy is a valid one, it depends on the perception of outside actors (the users as observers of the system). In the context of this study however, I am more interested in the actual properties of the system that give it a degree of agency, rather than the perception of humans with regards to the agency of the system. I am therefore actually following the position of Nandhakumar et al. (2005), who also argue that what characterises human agency is intentionality (Giddens, 1984), but what characterizes machine agency is affordance (Gibson, 1979; Norman, 1988).

2.8.1.1 Concept of human and machine agency in current research

From the discussion above, the following figure summarizes the interrelationship between human (user) and machine (ERP) agency in the use of the system.

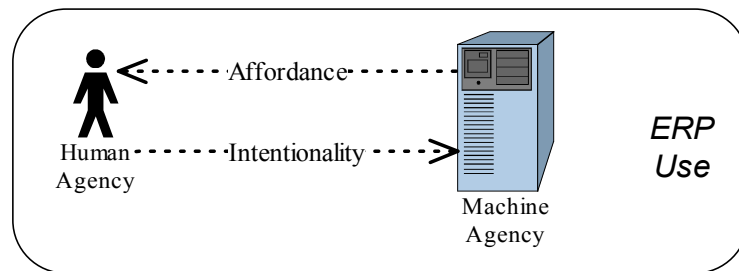


Figure 2: Concept of Human and Machine Agency in Current Research

The concept of human agency in particular in the context of ERP use can be linked to the concepts of embedding and disembedding. Although the weight of this thesis is on the interplay between human and machine agencies in explaining control and drift through ERP use, the concept of embedding/disembedding can also help account for the way users act in the system and the impacts of those actions (Ignatiadis and Nandhakumar, 2005, 2006a, 2007b). The concepts of embedding/disembedding are presented next, as the second theoretical base of this research.

2.8.2. Embedding-disembedding

Giddens (1990) defines disembedding as “the lifting out of social relations from local contexts of interaction and their restructuring across indefinite spans of time-space” (p. 21). Conversely, embedding (or reembedding) is according to Giddens, “the reappropriation or recasting of disembedded social relations so as to pin them down (however partially or transitorily) to local conditions of time and place” (pp. 79-80).

In the current context of the use of ERP systems, the social relations that are being disembedded and reembedded refer to the actions of humans (users) in the ERP system, and the way those actions impact actions of other users in the system. In that sense, an action by a human agent (user) in the system is disembedded from the local context where it is carried out (a particular functional and geographical area), to other (functional and/or geographical) areas. Similarly such a disembedded action is consequently reembedded locally, by being used by other users that may depend on the disembedded action for carrying out their work in the system.

For Giddens (1990) there are two types of disembedding mechanisms: symbolic tokens and expert systems (not in a computer science sense). Although Giddens concentrates mainly on money, symbolic tokens in general are media of exchange that can be circulated without regard to specific characteristics of the people or groups that handle them. Expert systems are then organizations of technical accomplishment or professional expertise that make a significant contribution to the material and social environment in which we live.

While Giddens (1990) views symbolic tokens and expert systems as mechanisms for disembedding, it can be argued that symbolic tokens and expert systems can themselves be disembedded (and consequently reembedded). Jones and Dugdale (2002) have demonstrated this with the example of the Activity-Based Costing (ABC) accounting system, which they claim can be viewed as an expert system, which can itself be disembedded and reembedded. Similarly, Seal et al. (2004) have identified some general properties of accounting, which gives it characteristics of an expert system (others of which can include marketing, purchasing, quality assurance and logistics) in disembedding and reembedding relations in a supply chain. In addition, Hanseth et al. (2001) have argued that an Enterprise System (e.g. SAP) is a disembedding mechanism in itself. This is because it contains a “language”, i.e. symbolic tokens, in which processes (working procedures that have to be adopted by the organization to use the system) may be specified and represented. In the context of this study however, I am taking a different approach, focusing on the embedding and disembedding of actions within the ERP system, as opposed to viewing an ERP system as a disembedding mechanism on its own.

In the context of ERP systems, it can be argued that the expert system as defined by Giddens (not an expert system in computer science terms) consists of

characteristics of the system which enable the disembedding and reembedding of user actions. Those are the single database offering visibility of user actions, as well as the rules and procedures inscribed in the system, in terms of a workflow definition guiding the disembedding and reembedding processes. Those characteristics also form part of the machine agency of the ERP system. Similarly, it can be argued that the symbolic token that enables the disembedding and reembedding of actions in the ERP system is the information residing and used within the system. User actions in the system then result in the disembedding and consequent reembedding of this information.

The disembedding and reembedding of human actions in the system can also lead to power differentials (Ignatiadis and Nandhakumar, 2005, 2006b), can impact organizational control and drift (Ignatiadis and Nandhakumar, 2007a), and can at the same time impact on the resilience of a company to respond to future challenges (Ignatiadis and Nandhakumar, 2006a, 2007b).

2.8.2.1 Concept of embedding-disembedding in current research

From the discussion above, the following figure presents the concept of embedding-disembedding as used in this thesis. This concept further elaborates the human agency part in the use of the ERP system. A disembedded action of a user in this case refers to the input of data by the user in the system. Because of the global nature and single database of the system, this action (data input) is disembedded (made available) to other locations (functional and geographical) where the ERP system is installed. This action (data input) can then be reembedded (appropriated, used) locally by other users of the system (in other functional or geographical locations) in order to carry out their work in the system. Those users may then enter new data in the system as a consequence of this, causing the disembedding-reembedding processes to operate in cycles.

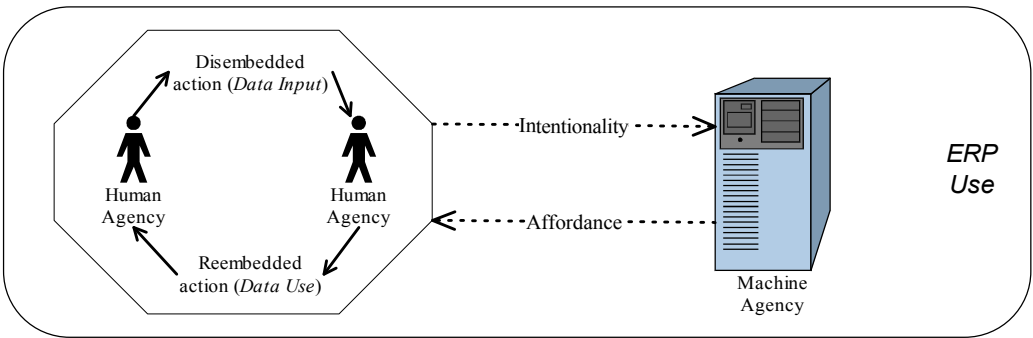


Figure 3: Concept of Embedding-Disembedding in Current Research

As has been mentioned, the two concepts of human/machine agencies and embedding/disembedding have been developed bottom-up from the data collected from the case study companies, also taking into account existing literature. Central to this thesis are also the concepts of control and drift, which are presented next.

2.8.3. Organizational control

The concept of control and its application in ERP systems was presented in the literature review in sections 2.4 and 2.6 respectively, and is used as a sensitizing device (Walsham, 1993) in the current research. I refer to control in this thesis as organizational control which can (a) influence or (b) become engendered by the use of an ERP system. As such, the concept of control falls under Orlikowski's (1991) classification of "control through technology". Although the focus is on control through technology, this forms part of overall organizational control. The latter in the context of this thesis is interpreted to mean adherence to the company's processes and procedures, as well as efficient management of the company's data.

As the analysis of the case study data in chapters 4 and 5 shows, organizational control *influencing* the use of the ERP system can include (pre-existing) internal organizational factors such as the presence and influence of the IT department over the use of the system, or the power given to certain users in the system. It can include the need to adhere to external mandates such as legislation, necessitating the implementation of the necessary control procedures in the system. It can also arise from the level of integration of the ERP functionalities (with more integration meaning better control over the company's data and procedures).

Organizational control as an *outcome* of ERP use can then encompass both behaviour and output control (Ouchi, 1977). Behaviour control as will be shown in the analyses of the case study companies can be facilitated with access controls for the use of the system, as well as the panoptic (visibility) features of the ERP system. Output control can then be facilitated with the production of reports from the system.

The next section describes the concept of drift as it is adopted in the current research.

2.8.4. Organizational drift

The concept of drift and its application in ERP systems was presented in the literature review in sections 2.5 and 2.6 respectively. Similarly to the concept of control, the concept of drift is also used as a sensitizing device (Walsham, 1993) in

this thesis. In the same way that the concept of control in the current research was defined (i.e. control through technology), drift in this thesis also refers to “drift through technology”. Although the literature on drift is concerned mainly with drift during the implementation of an IT system, the concept of drift in this thesis is broader, referring to (a) organizational drift influencing or (b) engendered by the use of an ERP system.

Drift through technology then forms part of overall organizational drift. This means that some loss of control over the way the company envisaged of managing its data and processes would occur. Drift in this case does not always (although it may) carry a negative connotation with it, but generally refers to different modes of ERP use (or disuse), relevant to the system’s envisaged role in the company.

As will be shown in the analysis of the case study companies (chapters 4 and 5), (pre-existing) organizational drift *influencing* the use of the ERP system can arise because of a previous poor implementation history of the ERP system, lack or insufficient training regarding the system, resistance to the system by users, or inadvertent power differentials created by the implementation of the ERP system. Drift influencing the use of the ERP system can be intentional (e.g. the company purposefully not wanting to fully control its operations via the ERP system), or can be unintentional (e.g. users using the system in unintended ways).

Organizational drift as an *outcome* of ERP use can then arise because of the bypassing of system controls, the interpretive flexibility of users in the system, the quality (or lack) of data input by users in the system, as well as various properties of the system.

In addition to the concepts of human/machine agencies, embedding/disembedding and control/drift, literature on ERP systems was also used as a sensitizing device in the analysis of the case study data. Such literature is summarised below.

2.8.5. Synthesized framework

Based on the above presentation of the concepts to be used as sensitizing devices in this research, the following figure presents a synthesized framework to be used in the examination of the case study companies.

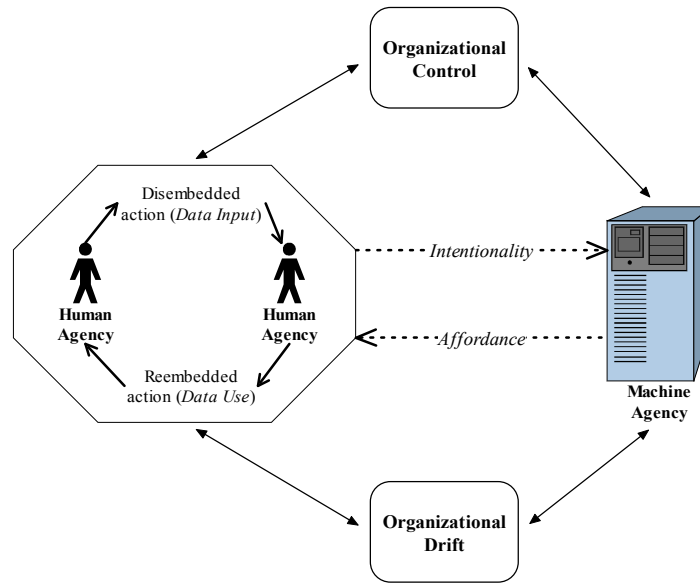


Figure 4: Synthesized framework for the examination of the case study companies

The above defined concepts of human and machine agencies and embedding/disembedding were identified bottom-up from the data collected from the case study companies. These concepts were identified as appropriate for defining the use of the ERP system by its users according to the capabilities offered by the system and the interdependencies amongst user actions in the system respectively. These were then supplemented in the analyses and discussion of the case study companies by some other concepts which emerged bottom-up from the collected data and which are presented next.

2.8.6. Other sensitizing devices

The concepts of human and machine agency, as well as embedding/disembedding are used as sensitizing devices (Walsham, 1993) in the examination of the case study companies. In addition to these concepts, the analyses and discussion in chapters 4 and 5 is also sensitive to some of the literature described in the previous sections of this chapter, and in particular the interpretive flexibility of users in their use of the system, as well as the panoptic (Sia et al., 2002) features of ERP systems. In addition, concepts such as organizational power differentials, empowerment, resistance and culture were also identified as factors impacting ERP use, and as such are discussed in the following sections.

2.8.6.1 Organizational power

Although it is not easy to precisely define power, and the literature on power of organizational actors is prolific (e.g. Clegg and Wilson, 1991; Doolin, 1999; Hardy, 1994; Jermier et al., 1994b; Knights and Roberts, 1982; Law, 1991; Mintzberg, 1983, 1984; Pfeffer, 1981, 1992a, 1992b; Salancik and Pfeffer, 1977), a brief overview is given here, as “power differentials” was found during the analysis of the case study data to be a factor affecting the use of the ERP system.

Pfeffer (1992b) in this case defines power as “the potential ability to influence behaviour, to change the course of events, to overcome resistance, and to get people to do things that they would not otherwise do” (p. 45). In similar lines, Morgan (1997) defines power as “the medium through which conflicts of interest are ultimately resolved” (p. 170).

Morgan distinguishes between two sources of power – power as a resource (i.e. something one possesses), and power as a social relation characterized by some kind of dependency (i.e. as an influence over something or someone). Giddens (1979) similarly views two forms of resources that can be used to generate power: Authoritative resources are used to generate power over persons, and allocative resources are used to generate power over objects.

Knights and Willmott (1984) however point to the problem of conceptualisation of power in general. In this case the following questions arise (p. 23):

- Is power a property or a relationship?
- By whom or what is power possessed or exercised: by agents (individual or collective) or by structures or systems?
- Does exercising power by some reduce the power of others? (Is it a zero-sum concept?)
- Does the concept only apply where there is conflict of some kind, or resistance?

Giddens (1984) answers some the questions posed above by Knights and Willmott. Power in this case is not necessarily linked with conflict in the sense of either active struggle or division of interest, and power is not inherently oppressive. For Giddens power is “the capacity to achieve outcomes... Power is not, as such, an obstacle to freedom or emancipation, but is their very medium – although it would be foolish, of course, to ignore its constraining properties” (p. 257). Giddens also connects human agency to power, stemming from the fact that loss of capacity to act is also powerlessness. Having talked about the importance of agency in power relations however, Giddens also acknowledges that power presumes structures of domination where power derives from the processes of social reproduction. For Giddens, power is not a zero-sum game: in all social systems there is a dialectic of control, such that there are normally continually shifting balances of resources, altering the distribution of power.

Knights and Willmott (1984) however have criticised Giddens's relational view of power, where it is seen only as 'over others', not 'with others'. They argue that Giddens neglects to consider how controller and controlled, in acting as if they were independent of one another, pursue their own interests in ways that unintentionally impede rather than advance collective power. Similarly, Knights and Roberts (1982) argue that while power may appear to reside in an individual or a system, in the end it is a property of social relations.

In the area of IT, Lee (1991b) argues that personal power and influence are in a large extent based on a set of power bases (resources), and that IT can enhance personal influence through the impact it can have on those power bases. He sees five of those power bases, all of them aided by the use of IT: Resource Provision (IT allowing provision of critical information to others), Irreplaceability (by persons holding unique IT skills), Authority (IT enhancing information-processing capabilities in higher organizational positions), Network Centrality (IT facilitating provision of resources and frequency of contact with others by actors at central and strategic points), and Expertise (IT facilitating links with larger environment and learning of new skills outside of immediate job scope).

Relevant to the above discussion and in the context of this thesis, the concept of organizational power regarding the use of an ERP system refers to the perceived authority by some organizational actors (managers and system users). It is relational in the sense that managers may influence and direct the way that users use the ERP system, but also deriving from knowledge by users of the ERP system, in a Foucauldian (Foucault, 1980) way, where an increase in expertise and knowledge (with regards to the ERP system in this case) implies an increase in power.

Although power differentials of organizational actors (e.g. managers or users) relative to other actors were found in this thesis to be a factor influencing the use of the ERP system, it was also mentioned by the interviewees that by the organization explicitly giving users more authority to carry out tasks in the system, organizational benefits were gained. As such, the concept of empowerment is discussed next.

2.8.6.2 Empowerment

The Oxford English dictionary defines the verb "empower" as 1. to authorize, license, 2. give power to; make able. Thomas and Velthouse (1990) mention that in a legal sense, power means authority, so that empowerment can mean authorization. They also view power as energy, in which sense to empower can also mean to energize. Ball and Wilson (2000) associate empowerment with self-management, proactivity, choice and freedom.

One would need to distinguish however whether empowerment is for the benefit of the organization or the individual. Clement (1994) describes the former as “functional empowerment”, referring to giving employees greater responsibilities, whether they choose so or not. Clement describes the latter as “democratic empowerment”, referring to the rights of people in being viewed as equals with regards to decisions that affect them. Clement argues for a mixture of the two approaches, in order for empowerment to be authentic and effective within an organization. In a case study of two organizations however, Panteli and Corbett (2004) have argued that in “empowered” organizations the systems were set up to guide the users in their daily activities, restricting their judgement and creativity. In that sense Panteli and Corbett argue that empowerment is not authentic, but rather more appropriately seen from the “functional” point of view.

With regards to the relationship between empowerment and control (which is a concept central to this thesis), some authors view them as opposites. Thomas and Velthouse (1990) for example conceptualize empowerment as the “pull” of the task, as opposed to the “push” of the management, that is associated with the traditional command-and-control types of structures. Other authors however claim that there may not be zero-sum constraints between empowerment and control (Das and Teng, 1998; Dillard and Burris, 1993), or that empowerment may in fact require greater control (Simons, 1995a, 1995b).

According to Randolph (2000), the main differences between the command and control (or hierarchical) and empowerment cultures can be summarized by a series of keywords, as the table below shows:

Table 2: Differences between Hierarchical and Empowerment Cultures (Source: Randolph (2000))	
Hierarchical Culture	Empowerment Culture
Planning	Visioning
Command and Control	Partnering for Performance
Monitoring	Self-monitoring
Individual Responsiveness	Team Responsibility
Pyramid Structures	Cross-functional Structures
Workflow processes	Projects
Managers	Coaches / Team Leaders
Employees	Team Members
Participative Management	Self-directed Teams
Do as you are told	Own your own job
Compliance	Good Judgement

Randolph (1995) sees information sharing as the first and most critical step to empowerment, in order to give employees the opportunity to act responsibly. Information sharing then implies a raised level of trust in the organization. Even in empowered organizations however, boundary controls still need to be in place to define the limits of action of employees. According to Randolph (2000), in an

empowered organization boundaries define the areas where people have the autonomy and responsibility to operate. These boundaries can stretch like rubber bands, as people develop new skills. In contrast, in a hierarchical organization boundaries are used to define what people cannot do. In this sense, they operate like barbed wire, to keep people in limits.

Empowerment is important in studies of the organizational impact of IT (Clement, 1994; Psinos and Smithson, 1996). According to Psinos et al. (2000) however, "IS does not itself empower or lead to empowerment. IS instead were shown to support employees in fulfilling the responsibilities which have been brought on by empowerment. The use of IS, however sophisticated such systems may be, thus cannot be said to 'empower' employees, but rather empowerment is complemented by IS" (p. 225).

Panteli (2001) has also examined empowerment in relation to the improvement of customer services in the case of two companies. She argues that the use of Information Systems as empowering tools may have ambiguous and unintended consequences not only for the organization, but for the customer as well. She proposes that as a result of the increasing use of technology, the systems as opposed to the employees become in fact empowered. Whereas when the systems are down employees cannot do their work (in spite of their training and empowering skills), the systems handle all customer information and other important tasks, and have the in-built capabilities to decide when and how to carry out their work relative to customer processes.

Relative to the above discussion and in the context of this thesis, empowerment refers to the perceived view of the interviewed persons with regards to the ERP system. These views are discussed and compared in more detail in section 6.3.1. Some viewed empowerment as something that could be facilitated by the use of the ERP system, while others viewed an ERP system as totally removing any sense of empowerment whatsoever. During the interviews carried out the concept of resistance to the introduction and use of an ERP system also came up, the relevant literature of which is discussed next.

2.8.6.3 Resistance

According to Jermier et al. (1994a), resistance can be defined as "a reactive process where agents embedded in power relations actively oppose initiatives by other agents. As such, resistance is theorised to be shaped (but not completely determined) by a particular context and the content of what is being resisted" (p. 9).

Resistance behaviour can be classified in four levels (Coetsee, 1993, 1999): apathy (including inaction, distance and lack of interest), passive resistance (including delay tactics, excuses, persistence of former behaviour, and withdrawal), active

resistance (including voicing opposite points of view, asking others to intervene, or forming coalitions) and aggressive resistance (including infighting, making threats, strikes, boycotts, or sabotage).

In the area of Information Systems, Lapointe and Rivard (2005) have distinguished between different levels of resistance, from individual to group, and have argued that individual behaviours concerning resistance need to be analyzed in early stages of IS implementation and examine where they converge, while also looking at group resistance in later stages of IS implementation, which arises because of the convergence of individual resistance behaviours.

Although resistance regarding IT is seen by some authors as a negative effect (Kossek et al., 1994; Martinko et al., 1996) hindering adoption efforts, others view it as a means of users communicating potential flaws with an IT system (Marakas and Hornik, 1996), or as an impetus to achieve positive technological change (Kavanagh, 2004). Markus (1983) more generally argues that resistance can be seen as negative or positive: negative when it generates unwanted conflicts, whereas positive when it prevents the implementation and use of system that could lead to decreased organizational performance.

Markus (1983) has actually studied the link between power, politics, and the implementation of a management information system (MIS). She argues that as many management information systems are designed to distribute information to individuals in a certain way, MIS can alter the bases of power. Markus argues that individuals (or units) who gain centralised control of information coming from the new system are more likely to accept it as such, whereas others who lose that centralised control are more likely to resist it. Reversely, decentralization of control of information is likely to be accepted by the individuals (or units) gaining control and resisted by those losing it.

Resistance in this thesis refers mostly to apathy and passive resistance (Coetsee, 1993, 1999), hindering the efficient adoption of the ERP system, while at the same time signalling potential problems with the system, or mismatches with the existing organizational culture. The concept of culture was also discussed during the interviews, and relevant literature is therefore presented next.

2.8.6.4 Culture

In interpretive studies such as the current one the concept of culture is relevant in order to be able to understand human actions and the way they are informed by the environment where they take place. The concept of culture was mostly noted during the examination of the main case study of this research, due to the larger number of interviews carried out in this company.

Although the number of definitions, conceptualisations and dimensions used to describe the concept of culture is big (see Straub et al., 2002), Trompenaars and Hampden-Turner (1998) define culture as “the way in which a group of people solves problems and reconciles dilemmas” (p. 6). One of the most widely accepted definition of culture however is that of Hofstede (1980), who defines culture as “the collective programming of the mind which distinguishes the members of one human group from another” (p. 260). Geertz (1973) also defines culture as “an historically transmitted pattern of meanings embodied in symbols, a system of inherited conceptions expressed in symbolic forms by means of which [individuals] communicate, perpetuate, and develop their knowledge about and attitudes toward life” (p. 89).

Coombs et al. (1992) disagree with the view of culture as an object that can be measured and manipulated (e.g. Ouchi, 1981; Peters and Waterman, 1982; Pettigrew, 1988). This functionalist view of culture assumes a direct, positive and causal relationship between the management of culture and the promotion of organizational control leading to improved organizational performance (Robertson and Swan, 2003). Coombs et al. argue instead for a view of culture where the meanings or significations are constructed from social relations of objects and subjects, thereby adopting an interpretivist view of culture. In particular, the importance of symbolic media, such as values, significations and knowledge, is stressed, through which a common understanding of social reality is produced (Filby and Willmott, 1988; Knights and Willmott, 1988; Kunda, 1992). Culture in this sense also encompasses the roles, power relations, routines and practices of organizational members (Robertson and Swan, 2003). This perspective then brings into question the capability of management to create an organizational culture that can promote control so that the workers will work towards the interests of the organization.

In the case of the development and use of IT, culture according to Coombs et al. (1992) refers to the *meaning* of IT attached to it by its developers and users. This then implies that IT has not only a material existence, but also a social and symbolic one. Any changes in the meaning of IT are then enabled through organizational cultures. (Leidner and Kayworth, 2006) in a literature review of studies in Information Systems and culture, have also identified a stream dealing with the relationship of culture and IT use and outcomes (which is also relevant to this research), alongside others such as culture and information systems development, culture and information technology adoption and diffusion, culture and IT management and strategy, and the impact of IT on culture. Many of these studies utilised Hofstede’s (Hofstede, 1991, 2003) dimensions of culture (e.g. individualism vs collectivism, power distance, uncertainty avoidance, masculinity/femininity, short-term vs long-term orientation).

In this thesis however, although the concept of culture was not central, it is important to recognize it as an important factor influencing the use of the ERP

system. As such, organizational culture was seen to be an overarching concept that affected the importance given by users and managers to the ERP system, the training received by users, and the support given to them.

The above identified concepts are used as a lens (or sensitizing device) within an overall subjective research approach adopted in this study, which is described in the next chapter.

3. Research Approach

3.1. *Introduction*

The purpose of this chapter is to present the overall research approach adopted in the current study. The chapter starts with the ontological and epistemological stances adopted. The case study approach of this research is described next, followed by the research design and the selection process of the case study companies. The data collection approach is then presented, and the chapter concludes with the presentation of the methodology used for analyzing the data collected.

3.2. *Ontological Stance*

Ontology can be defined as the assumptions about the nature of reality (Burrell and Morgan, 1979; Chua, 1986). Ontological beliefs are then concerned with whether the world is objective and hence independent of humans, or subjective and hence existing through the action of humans in creating and recreating it (Orlikowski and Baroudi, 1991).

Relative to those assumptions and relevant methods, the literature is quite broad and contentious, and concerned with fundamental research philosophies often seen as dichotomous to each other (Fitzgerald and Howcroft, 1998). Such dichotomies can be broadly classified into the “soft” (subjective, interpretivist) and the “hard” (objective, positivist) sides.

The approach taken in this research is that of the “soft” (or subjective) side. As this thesis takes an “agency” perspective in the examination of ERP use, it assumes that the world of ERP use is subjective, shaped by the actions of users in the system, which in turn are enabled or constrained by the ERP system itself (the machine agency of the system).

My particular viewpoint (or lens) in this subjective ontology is the interplay of human and machine agencies in the use of an ERP system, as well as the further elaboration of human agency into the disembedding and reembedding of human actions in the system. My viewpoint therefore consists of the conceptualisations presented in Figure 2 and Figure 3 above.

Corresponding to the “soft” side of research dichotomies at the epistemological level is the interpretivist paradigm, which is adopted in this research. The next section discusses in more detail this epistemological stance.

3.3. *Epistemological Stance*

Epistemology can be defined as the theory or method of knowledge, in particular, how we acquire knowledge (Burrell and Morgan, 1979; Chua, 1986). In the IS field, as Hirschheim (1985) mentions, “IS epistemology draws heavily from the social sciences because information systems are, fundamentally, social rather than technical systems” (p. 13). More generally then, any social science needs to be interpretive, understanding the mental aspects associated with social action.

Three broad areas of epistemology can be followed in a research agenda: Positivism, Interpretivism and Critical Theory (Chua, 1986; Myers, 1997; Orlikowski and Baroudi, 1991). The basic tenets of positivism are objective facts, law-like generalisations and hypothetic-deductive accounts of scientific explanation (Archer, 1988; Myers, 1997; Nandhakumar and Jones, 1997; Orlikowski and Baroudi, 1991). In critical theory studies, the researcher attempts to critically evaluate and transform the social reality under investigation (Lyytinen and Klein, 1985; Orlikowski and Baroudi, 1991; Richardson and Howcroft, 2006). As the interpretivist paradigm is adopted in this research, this is discussed more in length in the next sections.

3.3.1. Interpretivism

The interpretive approach maintains that the positivistic methods of natural science are inadequate to the study of social reality (Chua, 1986; Lee, 1991a). Instead, interpretive methods of inquiry assume that our knowledge of reality is a social construction of human actors. Interpretivism rejects the possibility of an objective or factual account of events and situations, seeking instead a relativistic, albeit shared, understanding of phenomena (Orlikowski and Baroudi, 1991, p. 5). Value-free data cannot be obtained, since the preconceptions of the enquired come into play, and by the interaction of the researcher with the human subjects of the research, the preconceptions of both parties may be changed (Walsham, 1995a, p. 376). As Walsham (1993) characteristically declares, “in the interpretive tradition, there are no correct and incorrect theories but there are interesting and less interesting ways to view the world” (p. 6). However, one needs to be aware of and acknowledge one’s own biases in interpretive studies (Trauth, 1997), which in the current research are the sensitizing devices described in section 2.8.

Orlikowski and Baroudi (1991) view three criteria for the classification of a study as interpretive: (1) evidence of a nondeterministic perspective, where the intent of the research is to increase understanding of the phenomenon studied, within cultural and contextual situations, (2) the phenomenon of interest is examined in its

natural setting and from the perspective of the participants, (3) researchers do not impose their outsiders' a priori understanding on the situation.

The current research relates to those criteria, as (1) the purpose of the research is to increase understanding of the impact of ERP systems on control and drift, within the context of the use of such a system in an organization. (2) This phenomenon was examined from the perspective of the users and managers working with the ERP system, in the companies where the system was deployed. (3) The researcher adopted a semi-structured interviewing approach, avoiding imposing the researcher's own knowledge of the situation, but letting the interviewees express their own thoughts and ideas.

The primary data sources in interpretive studies are interviews (Walsham, 1995b). Van Maanen (1979) names the interviewee's constructions as first-order data, while the researcher's constructions as second-order data. Second-order concepts depend upon informed theory and insightful analysis. Simply the collection of field data does not result in second-order concepts in itself, but that depends on the interpretation of the researcher. In the current thesis the first order concepts are the accounts of interviewed employees of the companies examined, while the second-order concepts are the interpretations of those accounts according to the sensitizing devices presented in section 2.8.

In interpretive studies in Information Systems in particular, neither human actions nor technologies are assumed to exert direct causal impact (Sahay, 1997). Consequences are then seen to be a result of the interplay of computing infrastructures, and objectives and preferences of different social groups (Markus and Robey, 1988). This is in line with the theoretical concepts (used as sensitizing devices) of human and machine agencies described in section 2.8.1, where both agencies interact with and depend on each other for the production of outcomes such as control and drift.

The next section discusses the issue of generalizability in interpretive studies.

3.3.2. Generalizability of interpretive studies

Walsham (1995b) argues that interpretive studies are generalizable to theoretical propositions with four types of generalizations: (1) the development of concepts, (2) the generation of theory, (3) the drawing of specific implications, and (4) the contribution of rich insight. The outcome of this research is mainly the contribution of rich insight, and to a lesser extent the development and use of concepts, presented in section 2.8.

Lee and Baskerville (2003) view four types of generalizability in interpretive Information Systems research: From empirical statements to other empirical statements, from empirical statements to theoretical statements, from theoretical statements to empirical statements, and from theoretical statements to other theoretical statements, as the table below shows.

Table 3: Four Types of Generalizability in Interpretive IS Research (Source: Lee and Baskerville (2003))

	Generalizing to Empirical Statements	Generalizing to Theoretical Statements
Generalizing from Empirical Statements	<u>EE</u> <i>Generalizing from Data to Description</i> This involves generalizing data to a measurement, observation, or other description	<u>ET</u> <i>Generalizing from Description to Theory</i> This involves generalizing measurement, observation or other descriptions to a theory
Generalizing from Theoretical Statements	<u>TE</u> <i>Generalizing from Theory to Description</i> This involves generalizing a theory, confirmed in one setting, to descriptions of other settings	<u>TT</u> <i>Generalizing from Concepts to Theory</i> This involves generalizing a variable, construct, or other concept to a theory

In the current research the most applicable types of generalizability as identified in Table 3 above are from data to description (type EE), as well as from description to theory (type ET). The data collected from the examination of the case study companies were used to describe the organizational phenomenon observed, i.e. the use of ERP systems (type EE), while those findings were also used to develop a conceptualisation regarding ERP use according to the impact of contextual factors on the use of the system, and the impact of the use of the system on organizational control and drift (generalizability type ET).

Having described the epistemological stance of the current research, the next section discusses the case study approach adopted. This is followed by the design of the research and the criteria and process for the selection of the case study companies. The approach in collecting the data from the case study companies is then described, followed by the methodology for analyzing this data. As this research is based on qualitative data collected from the companies, the advantages and disadvantages of this type of data are also presented.

3.4. Case Study Approach

As has been mentioned, interpretive approaches adopt a stance where the reality is socially constructed by human agents (Walsham, 1995a). Easterby-Smith et al. (2002) in fact position case study research as an interpretive (as opposed to positivist), researcher-detached (as opposed to researcher-involved) methodology. The case study approach attempts to capture and communicate the reality of a particular environment at a point in time (Jenkins, 1985).

According to Yin (2003), “case studies are the preferred strategy when how or why questions are being posed, when the investigator has little control over events, and when the focus is on a contemporary phenomenon within some real-life context” (p. 1). In particular relating to the use of case study research within an Information Systems setting, Benbasat et al. (1987) argue that this method is appropriate because of three reasons. First, one can study IS in their natural setting and learn about the state of the art. Second, case study research allows answering “how” and “why” questions, i.e. understanding the nature and complexity of the processes involving IS. Third, case study research is appropriate when few previous studies in the same area have been carried out. Although Yin (2003) as well as Benbasat et al. (1987) view case study mostly from a positivistic point of view, their above cited arguments are also applicable in interpretivist research (Weber, 2004).

As this research examines the question of “how” ERP use affects and is affected by organizational control and drift, case study research is an appropriate method. The investigator in this case was an outsider to the companies examined, had no consultancy or other interests in them, and therefore could not influence the events studied. The focus studied was a contemporary one, and the real-life context was the use of an ERP system in actual companies. In addition, as has been mentioned in section 2.7, very few previous studies examining the impact of ERP use on control and drift have been carried out, which also makes case study in the current research an appropriate approach.

Regarding the number of case studies, the choice is between a single case study and multiple case studies. The current research basically evolves around a single case study, but also aided with a number of auxiliary case studies. The use of the auxiliary case studies was not meant to follow a “sampling” logic, as this research adopts the interpretive paradigm. Rather, the purpose of the auxiliary case studies was to identify the issues involved with the use of ERP systems, to be examined in more detail in the main case study of the research, in addition to identifying commonalities and differences across all cases.

The next section presents the criteria and process of selecting appropriate companies to participate in the research.

3.5. Research Design and Case Study Selection

As Yin (1989) mentions, a research design in a case study is a technical plan that attempts to link the beginning and end of a research study, helping the researcher to get from “here” to “there”. There are then five important aspects of a research design: (1) The study’s questions, (2) Its propositions, if any, (3) Its units of analysis, (4) The logic linking the data to the propositions, and (5) The criteria for interpreting the findings.

In the present study, a summary of the study’s questions was presented in section 1.4. There are no propositions to be tested, as this is an interpretive research, whereas Yin views case study mostly from a positivistic point of view. With regards to the unit of analysis involved in this research, Markus and Robey (1988) view three levels of analysis: individuals, organizations and society. This research is broadly concerned with the first two levels: individuals and organizations. Individual users in this case use ERP systems in a certain way, and the way they use these systems has an impact on organizational control and drift. On the other hand, in order for individuals to use the ERP system, organizational mandates and authorisations must be in place, to enable them to do so. The findings from the research were then interpreted using the sensitizing devices presented in section 2.8 (Chae and Scott Poole, 2005).

The research design of this research involved targeting large private-owned companies (either national or international companies with a presence in the UK). The reason was that large companies were considered more likely to have an ERP system from big vendors (such as SAP or Oracle) installed, as opposed to smaller companies or SMEs (which may use smaller scale or open-source ERPs). The reason for the choice of ERP systems from the big vendors was that the effects from their use would be more accentuated than would be the case with smaller scale ERP systems. In addition, companies from a variety of industrial sectors were targeted, in order to avoid potential bias from examining only one industrial sector. Similarly, various geographical areas in England were examined for suitable companies, instead of concentrating just in one area.

In order to identify relevant companies, listings of clients from the websites of big ERP vendors such as SAP and Oracle were examined. In addition, news and information from the Internet about the installation of ERP systems in large companies were also examined. This resulted in an initial list of companies which were targeted by letters, e-mails or phone calls to the HR or IS department, asking for their help with the research. This approach yielded very few replies however, most of them being negative.

In order to be able to better approach companies, the help of members of staff from the School of Management at the University of Bath was sought, who had relevant

contacts in the ERP industry. This approach proved much more successful, leading to the following companies that showed interest in the research: Westland Helicopters, Oxford Chemicals, Huntsman Polyuruthanes, Chubb Fire, British Midland, DML, Reuters, BAA, TUI, PC World Business, Dell, NTL, Electrocomponents PLC, Honeywell, Multiyork, Saint Gobain, and Alstom.

All of those companies were then also contacted by phone and subsequently by e-mail, in order to explain in more detail the purpose of the research and the effort that would be required. Some companies were also visited at their premises in order to present the research in more detail. After discussions with all of the identified companies with regards to their participation in the research, the following five finally agreed to take:

- Multiyork
- Chubb Fire
- NTL
- Reuters
- Alstom

Of those five companies, Multiyork mentioned that it would only be possible to interview the IT Manager, and only with telephone interviews. Similarly, Chubb Fire mentioned that it would only be possible to interview the Purchasing Manager (with face-to-face interviews), due to the unavailability of other staff. NTL also mentioned that it would only be possible to interview one or two supply chain managers. Reuters mentioned that it would be possible to interview some IS managers, as well as some staff actually using the ERP system. The most promising access was in fact given by Alstom, who showed great interest in this research. In this case, the possibility arose to examine many offices of Alstom in the UK, and a number of users and managers working with the ERP system.

Because of this difference in the access allowed to the five companies, the first four companies (Multiyork, Chubb Fire, NTL, Reuters) served mainly as a vehicle for understanding general issues of ERP implementation and use. The main case study was then Alstom, where those issues were refined and examined in more detail. Although the companies differed significantly amongst them in terms of the sector, size, ERP system, nature of business, familiarity with and success of installation of the ERP system, this diversity helped to better examine issues with ERP use from a broad perspective. As such, this research combines the benefits of using a single case study approach (such as in-depth examination of the issues of interest) with the benefits of using a multiple case study approach (such as comparing results across cases, wherever this was possible) (Benbasat et al., 1987; Yin, 1989, 2003).

Having introduced the companies participating in this research, the next section describes the approach of data collection from those companies.

3.6. Data Collection Approach

Although in interpretive studies the data collected are mostly qualitative (Archer, 1988; Klein and Myers, 1999; Nandhakumar and Jones, 1997; Walsham, 1995b), this is not necessarily always the case (i.e. interpretive studies can also be carried out with quantitative data, although the number of such studies is much less compared to interpretive studies with qualitative data). However, the data from this research were purely qualitative, collected by means of interviews.

Walsham (1995b) in fact argues that in the case of an outside observer in interpretive case studies (as the current one), interviews are the primary data sources, since this is the best way to access the interpretations and views of the respondents. Walsham (1995b) also argues for a balance between excessive passivity and over-direction in the running of the interviews. If the interviews are too closely directed, important data may be lost, and hence the richness of interpretation which is very important in interpretive case studies is lost. On the other hand, over-passivity (e.g. by not offering the researcher's own ideas or by not prompting with questions following a new direction taken by the interviewee) may lead to the conclusion by the interviewees that the researcher is either not interested in their views, and/or that the researcher has no views of his/her own regarding the matter in question. The latter can result in the interviewees doubting the professional competence of the researcher in the IS field, and may jeopardize future collaboration with the research project.

In the current research, semi-structured interviews were used. The interviewees were asked some open-ended questions according to written interview guidance notes (shown in the Appendices of this thesis), but they were free to elaborate on their own thoughts and digress when it was necessary. In response to those digressions, the researcher then adapted the questioning, in order to make the interviewees elaborate more on their views and ideas. In addition, if the researcher was puzzled by the responses or did not agree, he gave his own opinion and the interviewee was asked to comment on it. The interviews tended to be more focused as the research progressed compared to the initial interviews, as items of interest regarding the use of the ERP system begun to surface, and those needed to be elaborated in more detail in later interviews.

In the four companies of Multiyork, Chubb Fire, NTL and Reuters, the individuals allocated by the company in each case were interviewed. On the other hand, the possibility arose in Alstom to select individuals to interview. This resulted in being able to check for consistency and differences in responses. The interviewees in Alstom were selected according to their degree of involvement with the ERP system, as well as selecting a cross-section of users and managers from various departments and locations. The most promising of those individuals after a first interview were targeted for a second or even third interview.

With regards to the recording of interviews, Walsham (1995b) argues that although tape-recording interviews can provide a full transcript of what was said, interview subjects may be inhibited on the sight of a tape-recorder regarding sensitive or confidential material. Also, another disadvantage of full tape-recording is the time needed to transcribe the interviews or to extract something meaningful out of them. The alternative to tape-recording is to make rough but extensive notes during the interview and to write them up fully as soon as possible after the interview.

In the current research all interviews (with the exception of one due to sensitivity reasons) were fully tape-recorded in digital media, and then transcribed verbatim in a word processor. This was deemed necessary in order to capture the full conversation during the interview and the issues that the respondents deemed important. Confidentiality issues did not arise, as the phenomenon studied (use of ERP) was a common one across many companies, and the respondents were not bothered with the tape-recorder when asked whether they minded its use. In the case of the single interview that was not tape-recorded, notes were kept during the interview as fully as possible, and those were expanded after the interview. Notes were also kept after informal discussions with interview subjects, and when noting something of interest in the field (e.g. during the demonstration of the ERP system).

In total 47 interviews in all of the companies were carried out. The table below summarizes those interviews, while the detailed interview schedule is shown in the Appendices of this thesis.

Table 4: Summary interview results

Total Number of Interviews:	47 (50 man-interviews)
Of which,	
Face-to-face interviews:	42
Telephone interviews:	5
Total Interviews' Duration	43 hours 55 minutes
Total number of people interviewed:	36
Of which,	
Interviewed once:	23
Interviewed twice:	12
Interviewed thrice:	1
Total number of transcribed interview words:	299,240

The next section describes the methodology used for the analysis of the data collected from the interviews carried out.

3.7. Data Analysis Methodology

The methodology that is followed for data analysis in the current research is that described by Miles and Huberman (1994). Although the authors of this methodology give some general guidelines for the analysis of qualitative data, they mention that in the end a lot depends on the interpretation of the researcher and his or her analytical skills. Miles and Huberman (1994) in fact claim that their methods do not require prolonged training or a specialised vocabulary, and can be used as is, adapted, or new methods can be invented.

Miles and Huberman see three interrelated, recurring phases of data analysis in this case: Data Reduction, Data Displays and Conclusion Drawing/Verification. These three phases are guided by the data collected during the data collection period, as the figure below illustrates:

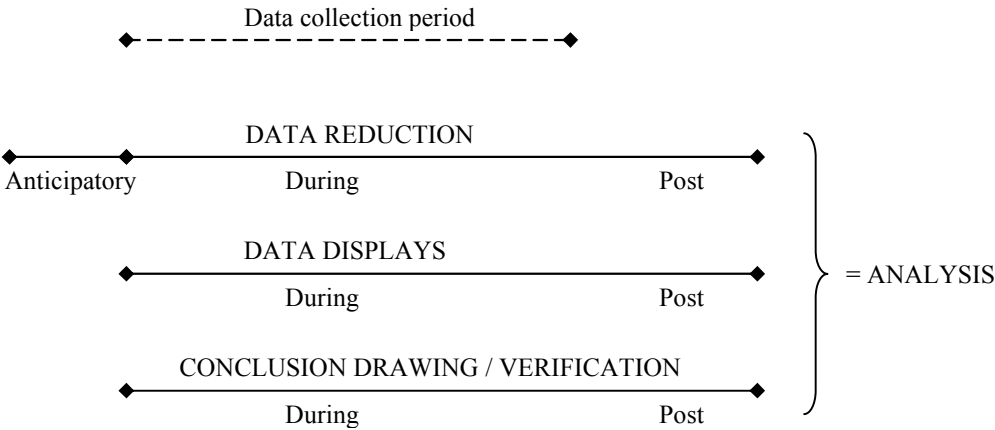


Figure 5: Elements of Data Analysis (Source: Miles and Huberman (1994))

The three streams of data reduction, data displays and conclusion drawing and verification do not operate in a linear fashion, but in a cyclical manner, throughout the analysis phase. The application of those phases in the current research is described in the sections below.

3.7.1. Data reduction

Data reduction refers to the process of simplifying and abstracting the qualitative data collected. This may include the sorting, discarding, sharpening and organization of data, in order to aid in the drawing of conclusions. Data reduction can be aided with the assignment of codes to pieces of text, which in the current research refers to transcribed interview data. Miles and Huberman in fact

distinguish between three types of codes: Descriptive codes entail little interpretation, but attribute a class of the phenomena to a segment of text. The same segment could also be coded with an interpretive code, where the researcher uses some of his or her knowledge about the background of the phenomenon in order to interpret the segment of text. Thirdly, pattern codes are even more inferential and explanatory.

In the current research a coding approach was also followed for data analysis, with coding done with the aid of the qualitative analysis software NVivo (Gibbs, 2002). Coding included mainly the transcripts of interviews, and to a lesser degree written-down observations from the field, researcher thoughts, and other forms of communication with respondents such as e-mails and informal discussions. NVivo was used mainly as a data management tool (for the categorisation and grouping of the research data into codes), as well as examining the interrelationships between the concepts that emerged during the coding process.

Within NVivo, descriptive coding was done through a first pass in-depth examination of the interview transcripts, where the text was examined, and portions of it (sentences, paragraphs, or sections) were assigned a code according to the phenomenon that they were describing. Some pattern coding also occurred at this stage, as codes were grouped into categories at various levels, which linked those codes together. This coding was more akin to a grounded theory approach (Glaser and Strauss, 1967), where codes evolved directly from the data. No particular theories were used to code the data at this stage; instead, the codes and categories emerged directly from the examination of the field data.

The figure below shows the codes that were developed in the first pass of coding in NVivo.

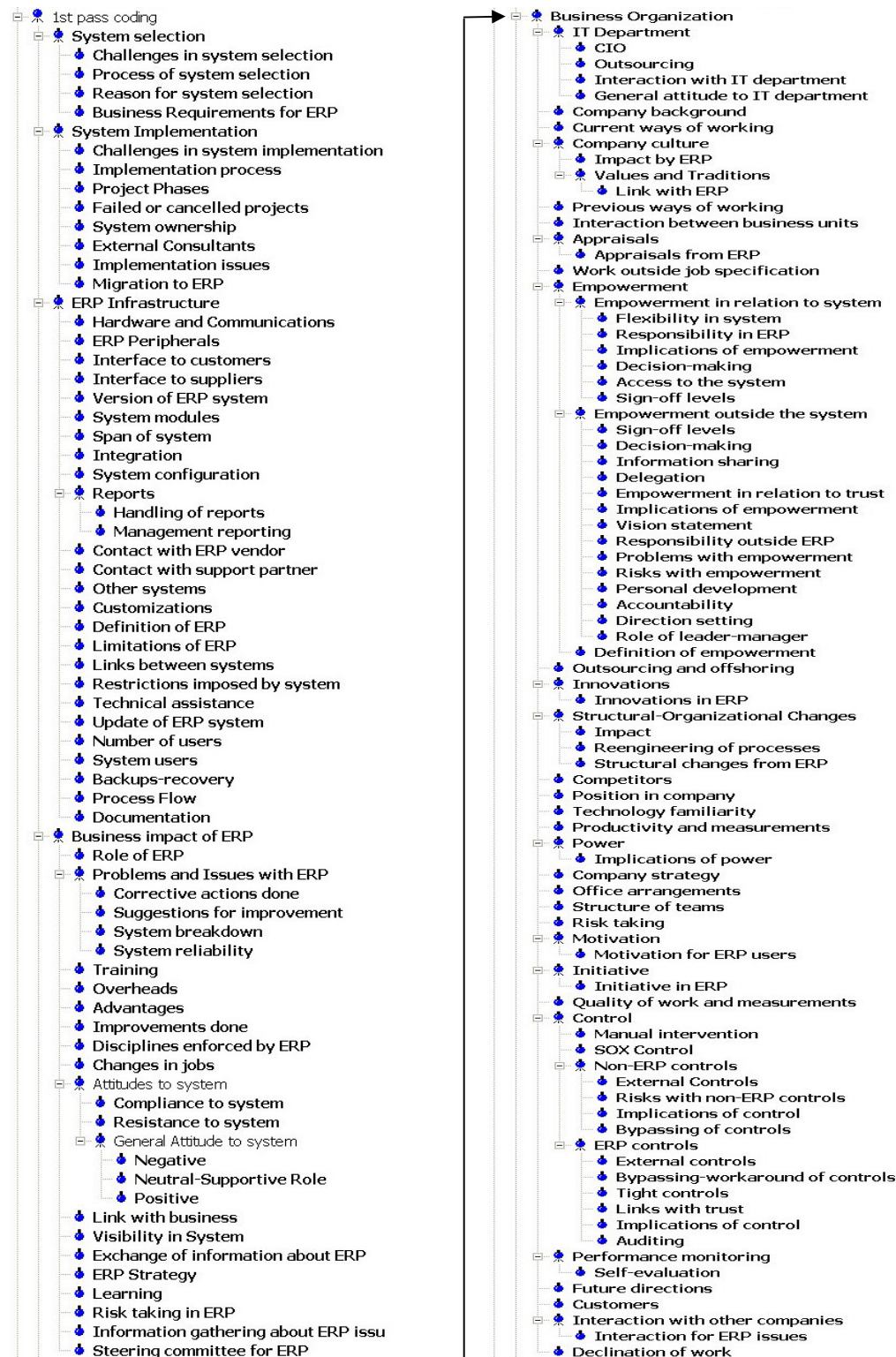


Figure 6: 1st pass coding in NVivo

After the first pass coding of the research data, a storyline dealing with the selection, implementation and use of the ERP system was starting to develop. This was sent to key informants from each of the examined companies, in order to get their feedback with regards to the accuracy of the reports and any omissions/inconsistencies. Minor comments were received with regards to some clarifications needed in the reports, and those were taken into consideration by keeping relevant memos in NVivo.

Although initial familiarisation with the field data (interview transcripts and observations/reflections of the researcher) occurred by the full transcription of them into an electronic format (in Microsoft Word), the first pass of coding in NVivo provided further insights into the themes that were emerging from the data. Although the coding that was done in the first pass was related more to the processes of system selection and implementation, the ERP infrastructure, the business organization and the impact of the ERP system on the organization, a closer inspection of each of the coded interview passages revealed that the use of particular theories could bring into light interesting themes regarding the use of the ERP system.

This prompted a second pass of coding, where the coding was more theory-driven, according to identified themes in the first pass, and literature that could support the concepts from the first pass of coding. The second pass of coding was more interpretive, in that segments of text were interpreted according to the sensitizing devices of this research, i.e. human and machine agency, embedding/disembedding, control and drift. However, data were not forced into predefined categories, as codes emerged not only from the literature and relevant theories, but also as a result of the first pass of coding, which was grounded on the field data.

Close examination of the coded passages in the first pass of coding revealed that there was a lot of talk about how users perceived the ERP system, as well as the actions that the ERP system afforded its users to take. In addition, the way that users used the system was also prominent in many coded passages. As such, the concept of human and machine agencies presented in section 2.8.1 was deemed important to include in the second pass of coding.

Similarly, many users described how they used the system, and how their actions in the system depended on, and influenced, the actions of other users in the system. As such, the theory of embedding/disembedding presented in section 2.8.2 was also deemed important to include in the 2nd pass of coding.

The actions of users in the system, and the properties of the system were seen to influence, and be influenced by, how organizational control (reflected in control through the ERP system) was implemented, or drift was occurring. As such,

various contextual factors were also deemed important in examining their impact on ERP use. The issues of control and drift and the context of ERP use were therefore also included in the second pass of coding.

The resulting coding structure is shown in Figure 7 below.



Figure 7: 2nd pass coding in NVivo

Having described the coding process and structure in the current research, the next section discusses how the interrelationships between the coding elements were elaborated.

3.7.2. Data displays

A data display is according to Miles and Huberman (1994) an organized and compressed assembly of information which permits the drawing of conclusions. Displays can include graphs, charts, networks, and many types of matrices.

Analysis in the current research also involved examining within NVivo the interrelationships between the developed codes and categories shown in Figure 7 above. Miles and Huberman propose amongst others the use of matrices (time-ordered, role-ordered, conceptually-ordered, etc) as a form of data display, which puts two or more categories into two or more dimensions in order to examine their interrelationships. In the context of the current research, some conceptual, two-dimensional matrices were examined, with the aim of findings linkages between the categories shown in Figure 7 (such as control/drift, embedding/disembedding, human and machine agencies).

Summaries of such conceptual matrices as produced within NVivo are shown in the tables below, each matrix containing the number of coding references from data that were coded with codes belonging to the corresponding categories. The numerical data (number of coded passages) shown in the tables below are not meant to be viewed in a statistical sense, and those may be inflated, as many passages were coded with more than one code, even within the same hierarchical category. They nevertheless indicated the correlations amongst the concepts, which prompted the further investigation of the relevant coded passages. For example, instances of human agency with regards to ERP use that led to drift were examined by looking at the relevant passages coded with both relevant codes (human agency *and* drift). Those passages were then used in the analysis in order to determine how human agency led to drift.

Table 5: Number of passages commonly coded in the dimensions of Human/Machine Agency and Control/Drift

	Control	Drift
Human Agency	103	137
Machine Agency	131	123

Table 6: Number of passages commonly coded in the dimensions of Embedding/Disembedding and Control/Drift

	Control	Drift
Embedding	53	54
Disembedding	71	63

Table 7: Number of passages commonly coded in the dimensions of Embedding/Disembedding and Human/Machine Agency

	Human Agency	Machine Agency
Embedding	26	29
Disembedding	48	44

Having described the examination of the interrelationships between concepts in the current research, the next section discusses the final element of data analysis, this being conclusion drawing and verification.

3.7.3. Conclusion drawing / verification

According to Miles and Huberman (1994), conclusion drawing comes from noting patterns, regularities, explanations, possible configurations, causal flows, and propositions. However, preliminary conclusions need to be held lightly by the researcher, until final conclusions are reached. Conclusion drawing is only half the story, in that verification is equally important. Verification according to Miles and Huberman can occur at various lengths, from a brief second thought, to a lengthy argumentation amongst colleagues, as well as trying to replicate findings in other data sets.

The previously described phases of data reduction and data displays are part of reaching conclusions. This is because reduced data and displays can be arranged coherently to permit careful comparisons, detection of differences, noting of themes and patterns, seeing trends, etc. Miles and Huberman in fact distinguish among 13 tactics for drawing and verifying conclusions. Those tactics and their relation to the current research are shown in the appendices of this thesis.

Having described the research approach of this thesis, the next chapter presents the four case studies of Multiyork, Chubb Fire, NTL and Reuters. As the number of interviews in each of those companies was quite low (two interviews in each of Multiyork, Chubb Fire, NTL, and five interviews in Reuters), those companies served as a means of examining general issues regarding the role of the ERP system and its use, without going into too much depth. As such, those companies served as auxiliary studies aiding in developing issues to be examined in more

detail in the main case study of Alstom, which was examined in more depth (with 36 interviews) and which is presented in chapter 5.

4. Auxiliary Case Descriptions, Analyses and Discussion

4.1. *Introduction*

As has been mentioned, the four companies of Multiyork, Chubb Fire, NTL and Reuters are presented in this chapter, while Alstom on its own is presented in chapter 5. This chapter facilitates the examination of general issues that influence the use of ERP systems, and the associated impact on organizational control and drift. Initial conceptualisations are also developed and the research questions that were summarized in section 1.4 are more elaborately developed.

It must be mentioned that all of the companies examined in this chapter and in chapter 5 are very much different from each other, both in terms of the nature of business they are in, the experiences and uses of their ERP system, as well as the organizational and cultural context where the ERP system is used. As such, the examination of the five case studies altogether can offer significant contributions regarding ERP use across disparate contexts. Although the level of examination of the four case studies described in this chapter and Alstom described in chapter 5 differs significantly, comparisons can still be made at a high level. Those are initially carried out in section 4.7 of this chapter in order to elaborate the research questions of this study. Comparisons between Alstom and the four companies of this chapter are also carried in section 6.3 of this document, where the results from all case study companies are discussed.

The presentation of each of the companies in this chapter starts with a general overview of the company and its activities, before presenting the ERP system they are using. The implementation history and the implications of implementing the ERP system are then presented. This is necessary in order to understand the contextual factors that could impact on the actual use of the ERP system. Those contextual factors are then summarized for each company in the form of control and drift that already existed in each company, either from pre-existing organizational mandates, from organizational procedures impacting ERP use, or from external factors. As limited data were collected from the companies in this chapter, some sections for each company may be missing, for example the implications of implementation or contextual factors impacting ERP use are not available for Multiyork, as they were still implementing the ERP at the time of the interviews. Similarly, the implementation history of the ERP system is not discussed for NTL, as the persons interviewed were not involved in the implementation of the system.

The actual use of the ERP system in each of the companies is then discussed. The more detailed analysis and discussion then follows with a summary of the instances of machine and human agencies and their interplay with regards to ERP use, as this was identified from the previous discussion about the company and its ERP system. This type of analysis is aided with the use of summary conceptual matrices (Miles and Huberman, 1994), in the form of tables detailing the relationship between human and machine agencies on the one hand, and control and drift on the other. In the case of Reuters, as relatively more data were collected (from five interviews compared to two interviews in each of the companies of Multiyork, Chubb Fire and NTL), it was also possible to further analyze (albeit to a limited degree) human agency according to the disembedding and reembedding of human actions.

The conceptualisation to account for ERP use and its impact on control and drift, also taking into account contextual factors (in the form of pre-existing control and drift) affecting ERP use is then presented for each company. The analysis and the development of the conceptualisation is informed by the second pass of coding which was described in section 3.7, with the coding structure shown in Figure 7.

In order to maintain consistency, the same presentation structure is also followed in chapter 5 when discussing Alstom. The next section summarizes the use of the four case study companies for creating knowledge.

4.2. *Plan for Knowledge Creation*

The analysis of the four companies in this chapter is based on the concepts of human and machine agencies, as well as (in the case of Reuters) the further elaboration of the human agency into the disembedding and reembedding of human actions in the system, as was discussed in section 2.8 of this document, and in particular in Figure 2 and Figure 3.

As has been mentioned, in each of the four companies of Multiyork, Chubb Fire, NTL and Reuters, a number of contextual factors is identified, in the form of pre-existing control and drift which impact the use of the ERP system. In addition, a number of factors from the ERP use itself, which impact organizational control and drift, is also identified.

Although the development of the research questions which are presented in section 4.7 of this chapter follows after the presentation of the four companies discussed further below, in reality the research questions were developed after the examination of all the five companies examined in this research. However, as Alstom is the main case study of this research which was examined in depth, and in order to devote the necessary space to discuss Alstom separately, the research questions in section 4.7 follow immediately after the presentation of the four auxiliary case study companies of Multiyork, Chubb Fire, NTL and Reuters, which are presented in this chapter. The use of the four case study companies in this chapter and Alstom in chapter 5 is summarized in the figure below. This figure conveys that fact that all five companies contributed to the development of the research questions, through the development of sensitizing devices emerging from the research data, and the consequent coding structure shown in Figure 7. These research questions were then examined in depth in Alstom.

Although when considering the number of interviews carried out in each company, the space devoted to the four auxiliary companies in this chapter altogether and Alstom in chapter 5 may seem disproportionate, it is necessary to present the companies in this chapter in as much detail as possible, in order to be able to understand the issues examined. In Alstom a comparatively larger number of interviews was carried out, however after some point the responses of the interviewees started to converge, and the results to become saturated. As such, a compendium of all the responses to the interviews carried out is presented in Alstom.

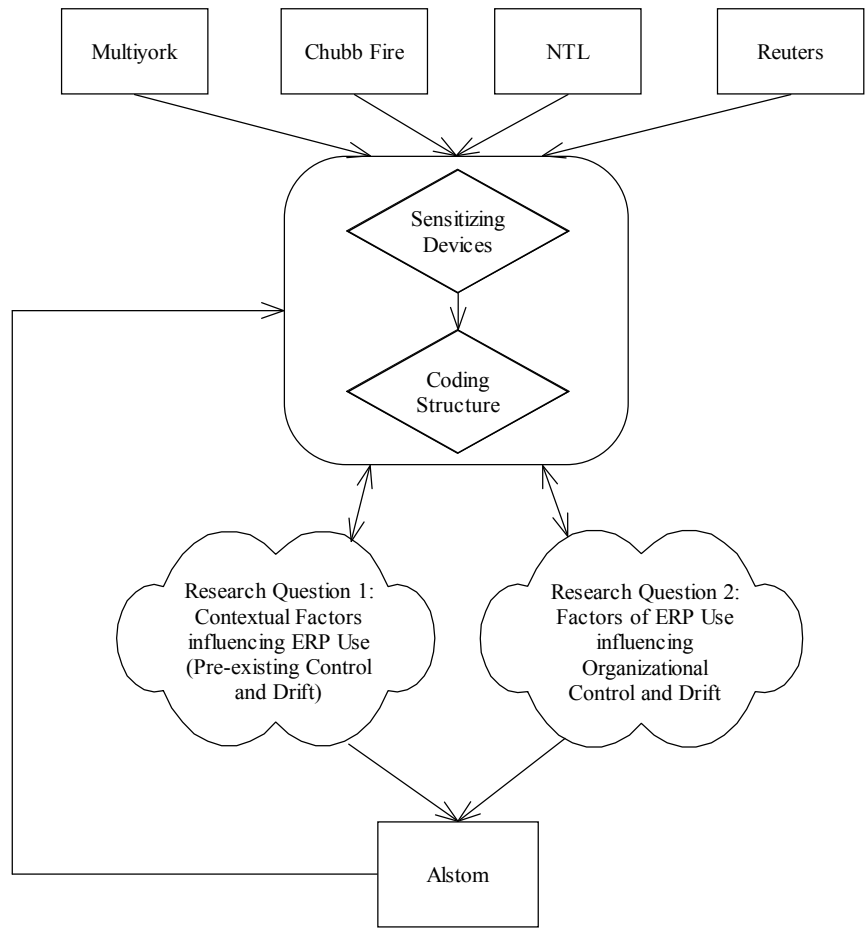


Figure 8: Knowledge creation from the examination of the four auxiliary case studies

The next section starts with the examination of the first case study company of this research, Multiyork.

4.3. *Multiyork*

4.3.1. Company background

Multiyork Furniture Ltd was founded in 1980 as a furniture manufacturer and seller, initially operating only one store and a tiny workshop in Suffolk. The company was acquired by Wade Furniture Group in 1995, and it is now a £55 million turnover company operating in the UK, with 61 stores. Multiyork is a vertical retail manufacturer, meaning that the bulk of the products that they sell in the stores, they also manufacture themselves. Their product range consists of around 30% cabinets and accessories, and around 70% upholstery. Multiyork employs around 300 retail staff, with an average of 4 employees per store, and a management structure above that.

4.3.2. ERP system

At the time of the interviews Multiyork was in the process of installing the SAP R/3 system. The modules concerned were Payroll, Finance, Production Planning, Materials Management, and Sales and Distribution. The role of the SAP system was seen to be partly strategic, in the sense that it allowed the business to roll out the entry of orders and the recording of stock movements directly at the stores. However, it was mostly the operational benefits of SAP that Multiyork was expecting to benefit from. SAP was replacing Multiyork's previous application, a system called Chairman, which was developed specifically for the furniture industry.

4.3.3. Implementation history

Although Multiyork had not finished the installation of SAP at the time of the interviews, the processes associated with the system selection and the project phases are described in the sections below.

4.3.3.1 System selection

With regards to the selection of a suitable ERP system to replace Multiyork's previous application (Chairman), one of the challenges faced was for the replacement system to cater not only for the manufacturing requirements, but also for the retail requirements. The difficulty was in finding a package that could cater for a manufacturer that also retailed through its own stores, like Multiyork. Among the issues that were involved was that the upholstery furniture was very heavily configurable by the customer when they placed an order. For example, Multiyork had around 11,000 fabrics that the customer could choose from, as well as different seat cushion or back cushion interiors, or even different frames and string combinations. After an iterative process of selecting suppliers, they ultimately ended up with their chosen ERP vendor, SAP.

One of the key requirements was for the system to be able to be rolled out to each of the stores. Before the introduction of the SAP system, the stores used to fill out their order pad using pen and paper, and then faxed that information back to the head office. Those orders were then manually keyed in to the old system, which could lead to many delays and problems, because of the need to manually check all the orders. If any mistakes were found, the order would have to be faxed back and forth between the store and the head office until it was right. SAP was seen to automate the order entry functionality in this case.

4.3.3.2 Project phases

The project was split into 4 phases. The first phase was the installation of Payroll, which started in late 2002, and had been completed by the time of the interviews. This went in relatively straightforward, with no real major issues. Phases 2 and 3 then involved the pilot and full rollout to the stores respectively, with phase 4 being the integration testing. At the moment of the interviews phase 2 was currently active, involving the pilot installation of SAP (the SD module) to a selection of stores.

Having described the implementation history of SAP in Multiyork and the reasons for its installation, the next section concentrates on the actual use of the system and the consequences, as those were reported from the small number of interviews carried out at Multiyork.

4.3.4. Use of ERP and consequences

4.3.4.1 Forecasting capabilities

From the initial tests carried out, SAP was seen to be very useful in the area of forecasting. The old application (Chairman) was a straightforward stock control system, whereas SAP had a number of inbuilt forecasting capabilities. The merchandising department were in fact looking at the capabilities in the forecasting area, so that they could better forecast their deliveries, particularly from the Far East, where a lot of the cabinets and accessories that Multiyork sold came from. It could be several weeks until the containers coming by sea arrived at the company's warehouses in the UK. As a result the company needed to be more accurate in terms of what the anticipated forecast was, to make sure that they could place the orders far in advance so that the orders would come in and be in stock to coincide with the anticipated forecast sales. The forecasting functionalities of SAP were seen to be very important in this case.

4.3.4.2 Tracking of orders

An advantage which was found out during the initial tests of SAP by Multiyork, was its ability to record the tracking, or the changes to the production order status as the relevant items went through the factory. Although the process in SAP was a direct replacement for what Multiyork did on their old software (Chairman), the way they managed it on their old software was at a high level.

For example, a sales order which belonged to a customer, could be for a small, a medium and a large sofa. Within SAP, that would be converted through the workflow into production orders. Those 3 items (small, medium and large sofa) would then become 3 independent entities within SAP. This was in contrast to the old software, where there was a production order header, which matched the sales order header. This meant that the 3 items were grouped together, and when the progress that the order was making through the factory was recorded, it was at order header level, and not at order item level.

The introduction of SAP however allowed the tracking of orders at item level. This was an improvement over the old system, and was needed in order to be able to offer detailed indications of where that order was in the factory. This information could then be used by the retail people, in order to inform customers as to the status of their orders. However, this also meant that the amount of information that workers in the factory had to enter into SAP to make this information available increased, although not by a very big amount.

4.3.4.3 Workflow

In Multiyork's old system, the recording of where the item had got to through the factory, although at the header level, was a memorandum type of notation, held in a text field. It was not a functional notation, which meant that if there was a problem

in the process, the system could not stop the order from being invoiced and dispatched to the customer. This meant that theoretically a delivery note could be raised in the system, and the item could be shown as delivered, and yet in actual fact not physically made.

By implementing a functional mechanism in SAP however, the order could be stopped from being dispatched and invoiced, if the people in the factory had not recorded the fact it got past their station. This meant however that everybody through the factory had to ensure that every piece of furniture that went past their station did get recorded in SAP. If this was not done, the situation could occur for example where finished items were physically being tried to be dispatched, but SAP would not allow this, as the workers in the factory had not recorded in SAP the fact that the item was finished in their part of the workflow activities of SAP.

4.3.4.4 Reporting

When manufacturing a piece of furniture, the process basically followed a 3 week production cycle: A cover was cut in week 1, it was sewn in week 2, and the upholstery was prepared in week 3. In reality each of those steps did not always go exactly one week apart, for example Tuesday-Tuesday-Tuesday. The sequence could be e.g. Friday-Tuesday-Thursday. However, the company wanted to report the sequence as week 1-week 2-week 3, e.g. Monday-Monday-Monday. In order to be able to achieve that, they needed to program that into the routing information that was attached to the bill of materials in SAP. The lackadaisical maintenance of that however, had caused the company big problems.

Multiyork was doing its reporting outside SAP, in Excel. Instead of configuring SAP to produce the dates in the format they wanted, a number of manual calculations were carried out in Excel, so that the figures that would come out on the printed schedules of delivery were actually correct. This patch outside of SAP (in Excel) however, meant that the capabilities of SAP were bypassed, whereas SAP did allow via some configuration to show the dates in the required format (with the steps of the manufacturing process being exactly one week apart).

4.3.4.5 Productivity measurements

Regarding departmental productivity, individual departments in the factories of Multiyork were measured on the number of pieces that went through them on a daily basis. Each week the load was prepared for the factory, and then the aim was to get all of those pieces through the factory. On a daily basis each of the various departments would then record all the items that went past them, e.g. for sewing, upholstery, etc. This used to be done manually, with pen and paper, but with the introduction of SAP this information could be obtained automatically from the

system. This information could then be used to present it at the management level, for example to see how many pieces had gone through that department.

Having presented the use of the ERP system at Multiyork, the next section analyzes and discusses those results according to the sensitizing devices of human and machine agency (presented in section 2.8.1) and the interplay between them. An initial conceptualisation is also developed to explain ERP use through the concepts of human and machine agencies, and their impact on organizational control and drift.

4.3.5. Analysis and discussion

4.3.5.1 Machine agency

From the above presentation of the way that Multiyork was envisaging using SAP from initial tests carried out, it can be seen that the system allowed certain actions, but disallowed others. For example, the system allowed the better forecasting of sales information, and the setting of the dates as one week apart to be displayed for various steps in the manufacturing process, although the actual dates for those steps differed. The system also allowed tracking of orders at the item level, whereas the previous system only allowed tracking for the whole order. There were also checks in the system of stopping creation of a customer invoice and despatch note if an item was not flagged as having been finished in the system. The system also allowed users at the factory floor to allow the recording of items passed through their department.

All of them were seen by the company as adding value to the company's operations, and increasing control over them. The enabling or constraining of such actions can be seen as a characteristic of the technological affordance, or machine agency of the ERP system, which is summarised in the table below. Relevant codes from the second pass of coding shown in Figure 7 are also shown in brackets in the table below, for the outcome of control from the machine agency of the ERP system.

Table 8: Technology Affordance (Machine Agency) of ERP system at Multiyork

Technology Affordance (Machine Agency)	Result (Control/Drift)
Better forecasting of sales	Control (System Properties)
Enabling setting of dates other than the actual ones for steps in manufacturing process	Control (System Properties)
Enabling tracking of orders at item level	Control (System Properties)
Stopping invoice and dispatch of an item if not finished correctly	Control (System checks)

Enabling recording of items passed through a department in the factory	Control (System Properties)
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4.3.5.2 Human agency

On the other hand, the capabilities of the system allowed users to obtain certain benefits by using the system. For example, users were able to order deliveries from the Far East in a “just-in-time” manner, by using the advanced forecasting capabilities of SAP. By recording the progress of item orders through the factory, users at the stores were also able to better inform a customer as to the status of his/her order. The progress of orders by the recording of items passed through a department in the factory also allowed users (such as managers) to obtain reports on the performance of particular departments.

All of the above were seen by the company as actions taken by users in the system enabling better control of the company’s operations. On other occasions, however, incorrect actions, or inactions by human actors (in this case the ones responsible for the configuration of the system) could result in loss of control through the ERP system. For example, the routing information attached to the bill of materials in SAP was not configured appropriately to present the dates of an item progressing through various departments in the factory as being exactly one week apart, which was a reporting requirement. As such, the company had to make a number of adjustments in the software (Excel) they were using for producing reports, in order to present the dates in the required format. This was mentioned as having created a lot of problems for the company, as the dates in Excel and the dates in SAP did not match. This could be seen as an instance of drift from the company’s ideal of implementing SAP to increase control over its operations, and resulted from using a system outside SAP (Excel), where data was not in synchronization with the data in SAP.

In other occasions, user actions could result in either control or drift. For example, the system enabled reporting the status of an item through the various departments in the factory, and could stop a process in the system if previous steps had not completed correctly (e.g. invoice generation and dispatch could not occur before an item was flagged as finished by all relevant departments in the factory). This meant that if at one step of the workflow a user forgot to input his/her part of the information in the system or if the information that was input was not right, then the item to be produced could be delayed, or could be produced incorrectly. This could be interpreted that at that point the company would drift with regards to the production of that particular item.

The table below summarizes instances of human agency at Multiyork with regards to actions in the system. The result (control/drift) is also shown, together with relevant codes (in brackets) from the second pass of coding (shown in Figure 7).

Table 9: Human Agency of ERP users at Multiyork

Human Agency	Result (Control/Drift)
Being able to better order items from the Far East	Control (System Properties)
Lackadaisical configuration of display dates in SAP, needing to update them in Excel	Drift (Use of external systems)
Being able to more accurately inform customer as to the status of an order	Control (System Properties)
Needing to put accurate information in SAP to portray the status of an item through the factory	Control, Drift (depending on the accuracy of information entered, 2 nd pass code: Data Accuracy and Quality)
Obtain reports on performance on particular departments	Control (System Properties)

Having described instances of machine and human agencies in Multiyork, the next section describes the interplay between the two.

4.3.5.3 Interplay between human and machine agencies

In many cases the ability of human users to act on the ERP system depended on the capabilities of the system. For example, in order for users to be able to use the “just-in-time” advantages for their orders from the Far East, the system had to be able to offer them the functionality for the better forecasting of sales. In other cases, the way that users used the system had an impact on what was produced from the system. For example, the lackadaisical configuration of display days in the manufacturing process meant that SAP could not produce those days in the format required by the company. Or if users forgot to enter information that an item was finished in their department, SAP could not carry out the generation of a despatch note and customer invoice. The table below summarizes the interplay between the machine agency of the ERP system and the human actions of users in the system. The outcome of the machine and human agencies (control/drift) is also shown in parentheses, as this was reported in Table 8 and Table 9.

Table 10: Interplay between human and machine agencies at Multiyork

Machine Agency	Human Agency
Better forecasting of sales (Control)	Being able to better order items from the Far East (Control)
Enabling setting of dates other than the actual ones for steps in manufacturing process (Control)	Lackadaisical configuration of display dates in SAP, needing to update them in Excel (Drift)
Enabling tracking of orders at item level (Control)	Being able to more accurately inform customer as to the status of an order (Control)
Stopping invoice and dispatch of an item if not finished correctly (Control)	Needing to put accurate information in SAP to portray the status of an item through the factory (Control/Drift)

Enabling recording of items passed through a department in the factory (Control)	Obtain reports on performance on particular departments (Control)
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4.3.5.4 Conceptualisation of ERP use

The interplay between the human and machine agencies described in the previous section is based on the assumption that machine agency is characterised by affordance, while human agency is characterised by intentionality (as mentioned in section 2.8.1). This means that actions by a human on the system depend on the capabilities of the system, and the system depends on the intentionality of humans to act on the system, for its correct functioning.

The machine agency of the ERP system was seen to increase control of the company's operations. In particular, control from the use of the system was seen to be facilitated by checks carried out by the system (e.g. for invoice and despatch notes), properties of the system enabling certain user actions, as well as the accuracy (quality) of the data in the system. Drift on the other hand was facilitated by the inaccuracy of such data, as well as the use of systems external to SAP (such as Excel for producing reports). Those findings from Multiyork are summarized in the figure below.

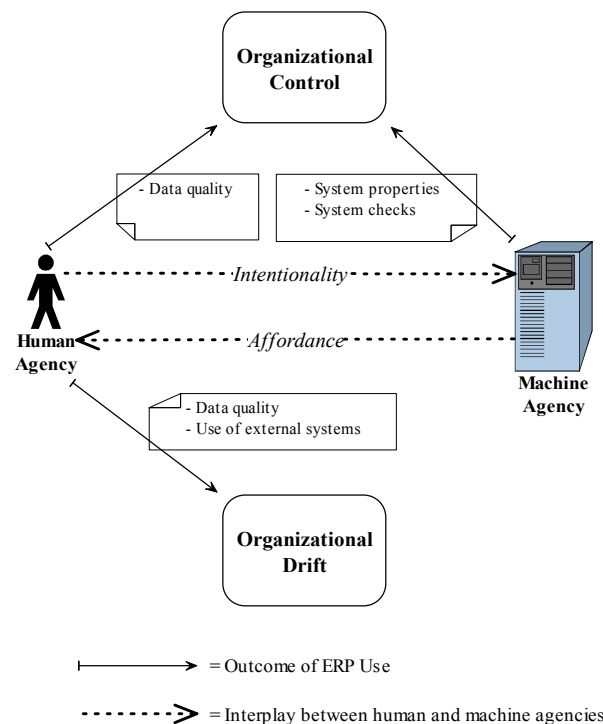


Figure 9: Conceptualisation of ERP use at Multiyork

It must also be mentioned that in the figure above no distinction is made between different users of the system, e.g. simple user, power user or users responsible for configuration. Human agency in this case comprises all of those types of human actors that may have some interaction with the system. In the case of Multiyork those users were the employees using the system for their day-to-day operations.

4.3.6. Summary of findings

As few data have been collected from Multiyork, the results are from a high-level point of view without going into much detail and without looking at the context of ERP use, but can serve to identify issues of interest regarding this research. The interplay between human and machine agencies in ERP use has practically been observed in Multiyork. From this interplay, the two outcomes of control and drift have also been observed. Those were categorized according to the coding structure presented in Figure 7. In particular, from the interplay of human and machine agencies in ERP use, control was observed from the quality of the data in the system, as well as various other system properties and checks carried out by the system. Drift on the other hand was seen to occur from the (lack of) data quality in the system, and the use of systems external to the ERP. Drift in this case meant that the company lost some degree of control over its intention of using the ERP system to better manage its processes. As Multiyork was still implementing the system at the time of the interviews, it was not possible to observe contextual factors (in the form of pre-existing control and drift) impacting the use of the system.

Having described and analyzed the company of Multiyork, the next section describes and analyzes the company of Chubb Fire, from which also a limited number of data (from two interviews) was collected. Nonetheless, the findings from Chubb Fire can also reveal complementary and additional insights into the consequences of ERP use in that company.

4.4. Chubb Fire

4.4.1. Company background

Chubb was originally founded in England in 1818, in response to an increase in crime led by the social changes that industrialisation brought. Chubb was acquired by an American company (United Technologies Corporation) in 2003. Today Chubb employs over 48,000 people, has two million customers, and annual sales of £1.5 billion world-wide. Chubb is split into 3 business units in the UK: (1) Chubb Fire, which deals with fire protection, fire prevention, fire extinguishers, and fire alarms, (2) Chubb Electronic Security, which deals with CCTV systems, camera systems, security systems, access control systems, and (3) Chubb Security Personnel, which deals with the provision of security guards and patrolmen working within large office complexes or around industrial sites.

Chubb is listed in the FTSE in the service support sector. This research examined the Chubb Fire division of Chubb. There are around 25 separate offices of Chubb Fire in the UK. Most of Chubb Fire's business is with other businesses. They do very little domestic or public sales; around 99% of their sales are in fact with other businesses.

4.4.2. ERP system

At the time of the interviews Chubb Fire had the SAP (R/3, version 3.1h) ERP system, which was installed at the end of 1998 in order to overcome the millennium issue. The modules of SAP that were used at the time of the interviews were Finance, Logistics, Materials Management, Inventory Management, Purchasing, Sales and Distribution. The view of the SAP system in Chubb Fire was as a back-office tool that they used to facilitate the day-to-day operations, but it was not seen to fit to any strategic planning of the company. In other words, the ERP system was used to organize, record and control data, rather than to control the strategic running of the business:

I believe that the business over the years has certainly benefited from the interactive nature of SAP, even though we are using it for the back-office processes; the fact that everything that is done in real time is recorded in real time, is visible in real time, is updating throughout the system in real time, I think that's important. (Purchasing Manager)

4.4.3. Implementation history

When SAP was originally implemented, the finance, purchasing, and the logistics inventory functionalities were installed, with the others added later on. All of the installed functionality was standard, off-the-shelf SAP. The system was purposefully not customized, as that was considered to make upgrading difficult. The implementation of SAP was also an opportunity for Chubb Fire to address legislative requirements, as the section below discusses.

4.4.3.1 Legislation

The business procedures in Chubb Fire tended to be closely intertwined with the ERP system, also driven by legislation. For example, as Chubb was part of an American corporation, the finance procedures were to a large degree dictated by the Sarbanes-Oxley (SOX) act. Some of the other functions were also service activities dictated by British standards. In that sense there was seen to be no real driver within the ERP system for the implementation of the relevant processes and procedures; those were in fact driven externally by legislation and standards.

As part of that however, the company had to document the way that they used SAP to achieve those aims. This was interfaced during the implementation with the operational procedures, in terms of how the business should work, and how SAP might be used to achieve those aims. Training was also important during the implementation of SAP, as the next section discusses.

4.4.3.2 Training

When the SAP system was installed at Chubb Fire, all of the users had to be given training on the specific tasks that they had to carry out in the system, replacing the procedures that they were previously following. The training process was formal in nature, involving one-on-one or group training sessions. In addition, there were management communication briefs that explained the need to use the system, and what the benefits were. Training also took place when somebody new joined the company, this training being a combination of using existing documentation, and one-on-one training.

The next section describes the implications of the implementation of SAP at Chubb Fire.

4.4.4. Implications of implementation

4.4.4.1 Power differentials

The implementation of the SAP system created “operational champions” within the business. For example in the finance department there was a person responsible for the ERP system, and similarly in the logistics team. Those people tended to be the focus if changes to the system were required, or if benefits to changing could be seen. As such, those people seemed to gain in authority with regards to making decisions about the ERP system.

One of those persons was the single interviewee at Chubb Fire, who took the lead for the supply chain logistics functionality of SAP. This gave him the benefit of understanding the SAP system on a broader basis than some of the people that worked for him. This meant that if they had problems with the system, he could usually offer them relevant advice.

4.4.4.2 Resistance

There was a degree of resistance to the system by its users as a result of its implementation. The introduction of SAP to the company meant that there was some reluctance to use the system, for example by the users that actually had to process new orders or invoices. As the interviewed person at Chubb Fire characteristically mentioned:

By its nature, some people will really want to make it work, will get into it. Others will still want to hang on with the old processes and systems and will be really reluctant to adopt the new system And then it comes down to the training, and the amount of time and effort the business spends communicating the changes and the benefits in the positives. And, you can probably never do too much of that. (Purchasing Manager)

As mentioned by the interviewee, the initial resistance to the system was overcome by appropriate training and communications to the users. This ensured that no drift occurred.

The next section summarizes the implementation of SAP and its implications at Chubb Fire, in terms of contextual factors that could impact ERP use. Such contextual factors could be categorized as either aiding (controlling) the company's operations, or going against them (drift).

4.4.5. Contextual factors impacting ERP use: control and drift

As was discussed, the installation of SAP resulted in the creation of power differentials, which served to increase control in the company. For example, the creation of “operational champions” responsible for the ERP system within each division of Chubb Fire was carried out in order to make sure that there was always a person responsible for the ERP in case problems arose. The company also recognized the importance of thorough training for all of the ERP users, in order to better control the way that those users used the system. Training was also very important in order to overcome any resistance from the users with regards to using the new system. Such resistance would mean that the company would drift from its original plans of using the ERP system to better control its operations. SAP was also installed as a means to better monitor and control the company’s compliance with legislative standards and procedures, such as the Sarbanes-Oxley (SOX) act.

Having described the contextual factors that could impact ERP use, the next section describes the actual use of the system at Chubb Fire, and the consequences of this use.

4.4.6. Use of ERP and consequences

4.4.6.1 Access profiles

Access controls implemented in SAP basically served to restrict the usage of the system to exactly the parts that a user was meant to use, at the same time keeping the integrity of the system. For example, someone who was able to raise a purchase order could not also receive a purchase order. It was necessary that those two disciplines were split, to avoid the possibility of people abusing the system. One of the benefits of an ERP system was then seen to be that user access could be tailored to that level of complexity, this complexity being quite major.

As another example of the split between responsibilities in SAP, within the inventory area the person who was counting the stock could not also do an additional check on the stock, and could not be the one who was also allowed to adjust the stock. The fact that there had to be a split between the functions of checking, recording and updating, ensured that there was an unbiased approach and further checks in the relevant processes.

The access profiles of system users also defined authorisation levels regarding the amount of financial data users could handle. Users could then make financial decisions in the system based on their authorisation levels. For example in the

purchasing area, purchase order expenditure levels could be set. Once those limits were set for individual users, they could then just go and raise purchase orders in the system, up to the limit that was assigned to them. Before the introduction of SAP, only the purchasing manager or one of the more senior managers would be allowed to sign off their purchase orders. Within SAP however, individual users could be made responsible to sign off purchase orders within limits, as the system would only allow them to generate the order if it fell within that limit.

4.4.6.2 Visibility

In addition to access profiles, another important aspect of system use was seen to be the visibility of user actions in the system:

You can see who's carried out the transaction, and you can take corrective action to understand why it happened. So, the system allows that visibility, to see where things have gone wrong, who's made what transactions, who's done what purchasing. (Purchasing Manager)

However, the system was not being used pro-actively, to examine for example whether a user within a certain time had accomplished a task that he/she was assigned. But if a manager wanted to inquire that, then the data was available in the system. Similarly, if someone did an incorrect posting or raised an incorrect sales order, then this would filter through to other parts of the system and could be visible to other users. The visibility in the ERP system therefore applied not only to upper management, but also to peer groups, in the same or across departments:

The possibility must always exist for members of the same team, peer groups, whatever, to spot errors made by their colleagues, regardless of whether using a system or not. I think it's going back to the disciplines that an ERP system enforce. Makes it an awful lot easier and probably a lot quicker to spot those errors. (Purchasing Manager)

The next section describes the use of systems external to SAP at Chubb Fire.

4.4.6.3 Use of other systems

Chubb Fire analyzed the reports that it needed to produce in Excel, instead of doing it directly in SAP. For example, a key process within the supply chain was customer order satisfaction, examining where the company was able to satisfy customer orders within the delivery time that the customer wanted. The relevant data was extracted from SAP into Excel in this case, in order to produce a management report that was presented on a monthly basis to senior management. This was needed in order to demonstrate that the customer orders were satisfied

within the given time span, and to a given satisfaction level. In this case the ERP system was used to download all the relevant data into Excel, and then manipulate them in a simpler, more graphic management report.

However, by taking data out of the ERP system and manipulating them in another piece of software (Excel) that did not impose access restrictions, data could be (intentionally or unintentionally) falsified, producing erroneous results. If this occurred, then control over the accuracy and truthfulness of those data would be lost, and drift would occur.

The next section analyzes and discusses the results from Chubb Fire as were presented above, in the dimensions of machine and human agency.

4.4.7. Analysis and discussion

4.4.7.1 Machine agency

As can be seen from the presentation of Chubb Fire above, their ERP system allowed certain actions but disallowed others. For example, SAP allowed the setting of different authorisation levels for different users when they created purchase orders. The system also allowed the split of responsibilities with regards to the actions that users could carry out in the system. For example, users who raised purchase orders could not also receive purchase orders. These mechanisms were implemented with the use of access profiles that controlled which actions a user could carry out in the system. The system also enabled the visibility of user actions in the system, either by superiors, or by peers. The former could examine the work of their subordinates in the system, and the latter could see if there were any mistakes by other users in the system.

These examples can be seen as instances of machine agency (the SAP system) facilitating control within Chubb Fire. In other cases, however, the capabilities of the system meant that drift could occur. This was the case with the use of systems outside SAP in order to process data produced by SAP. This was for example the case with using Excel to manipulate data that came out of SAP, in order to produce reports of a format that could not be produced within SAP. As it was mentioned, the use of Excel meant that data could be manipulated and falsified outside of SAP, which could result in drift from the company's original goal of using SAP to better control its data.

The outcomes (control or drift) of the machine agency of the ERP system are summarized in the table below. The relevant codes from the second pass of coding shown in Figure 7 are also included in brackets.

Table 11: Technology Affordance (Machine Agency) of ERP system at Chubb Fire

Technology Affordance (Machine Agency)	Result (Control/Drift)
Allowing visibility of user actions in the system	Control (Visibility)
Allowing setting of authorisation levels (as part of access profiles) for purchase orders	Control (Access profiles)
Allowing split of responsibilities in the system (as part of access profiles)	Control (Access profiles)
Not producing sophisticated reports	Drift (Use of external systems)

The next section discusses the results from Chubb Fire according to the human agency perspective.

4.4.7.2 Human agency

The capabilities of the ERP system allowed users certain actions and disallowed others. For example, constraining users on the financial amount of purchase orders that they could sign off on the system meant that users had to comply with this, and could not sign off in the system anything above the limit that was set to them. The fact that the system tagged user actions in the system and kept an audit trail also meant that this could be examined, if the need arose. The use of access profiles also meant that users could not abuse their profile by carrying out actions that their profile in the system did not allow. All of those aspects of the human agency meant that control in the company was increased.

In other cases however, human agency implied drift. For example, using Excel to produce reports meant that the ERP system was bypassed, and operations were carried outside of it, in software (Excel) that did not have any access controls, and where it was much easier to change and falsify data than inside SAP. As such, this could be seen as an instance of drifting from the control offered by the ERP system.

The table below summarizes the instances of human agency in the use of the ERP system at Chubb Fire, together with their outcome (control or drift), according to the coding schema in Figure 7 (the codes are shown in brackets in the table below).

Table 12: Human Agency of ERP users at Chubb Fire

Human Agency	Result (Control/Drift)
Examining the system to see which users performed which actions, in cases of query	Control (Visibility)
Individual users raising purchase orders according to their limits	Control (Access profiles)
Not being able to abuse one's profile	Control (Access profiles)

Using Excel to produce reports	Drift (Use of external systems)
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Having described instances of machine and human agency with regards to ERP use at Chubb Fire, the next section describes the interplay between those two types of agency.

4.4.7.3 Interplay between human and machine agencies

As was discussed above, the capabilities of the ERP system reflected on the actions that users could take in the system. This was the case with the system allowing different authorisation levels and access to transactions (as part of the access profiles of users), and the visibility of user actions in the system. Access profiles specified the actions that users could take in the system, while visibility allowed authorised users to examine the actions of other users. On the other hand, as the system did not produce adequate reports, this reflected on the users having to use Excel for the creation of reports.

The table below summarizes the interplay between the machine and human agencies with regards to ERP use. The impact as described in the table below is mostly from the machine to the human agency, in terms of the capabilities of the system and what actions those allow or disallow users.

Table 13: Interplay between human and machine agencies at Chubb Fire

Machine Agency	Human Agency
Visibility of user actions in the system (Control)	Examining the system to see which users performed which actions, in cases of query (Control)
Allowing setting of authorisation levels (as part of access profiles) for purchase orders (Control)	Individual users raising purchase orders according to their limits (Control)
Allowing split of responsibilities in the system (as part of access profiles) (Control)	Not being able to abuse one's profile (Control)
Not producing sophisticated reports (Drift)	Using Excel to produce reports (Drift)

The next section summarizes the results of the analysis in terms of a conceptualisation.

4.4.7.4 Conceptualisation of ERP use

With regards to the contextual factors (in the form of pre-existing control and drift) impacting ERP use (described in section 4.4.5), the company's intention to increase control meant that training played an important role. The intention to increase control was also due to external pressures such as legislation. The installation and use of the ERP system was seen to facilitate compliance to legislation in this case.

The creation of power differentials in terms of users (managers) having an overview and responsibility of particular system modules also served to increase control over the way the system was used by its users. On the other hand, espousal of the system by users was essential in ensuring that the foreseen control was facilitated. Resistance of the system by users would then mean that the company would drift from its intention of using the system to enhance control over its operations.

When the system was actually used by its users according to the capabilities that it offered, control was mentioned to arise because of the visibility of user actions that the system afforded, and the access profiles that defined acceptable user actions in the system, and which included authorisation levels specifying upper limits for financial transactions in the system. On the other hand, use of external systems such as Excel would mean that the company would drift from its ideal of using the system to control its data.

The figure below presents the conceptualisation of ERP use at Chubb Fire, and its interrelationship with control and drift.

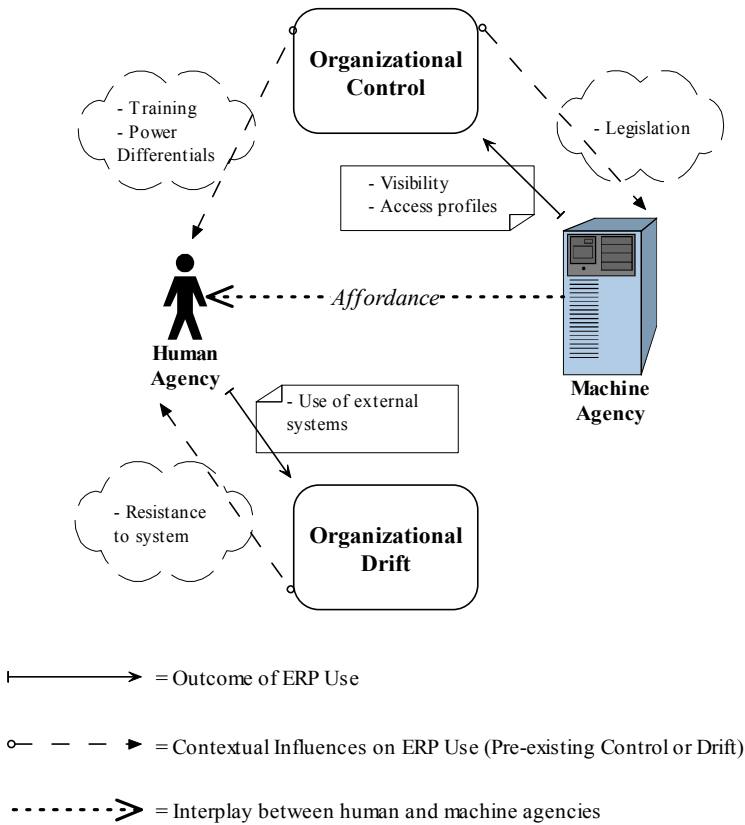


Figure 10: Conceptualisation of ERP use at Chubb Fire

4.4.8. Summary of findings and knowledge added

In Chubb Fire only the impact of machine agency on human agency was observed, according to the actions that the system allowed or disallowed users to take relevant to their use of the system. On the other hand, although in Multiyork no contextual factors (in the form of pre-existing control and drift) were reported, in Chubb Fire such influences were identified. The need to comply with legislation, the importance of training, and power differentials created by the introduction of the system were identified instances of pre-existing control impacting the use of the system. Initial resistance to the system (although later overcome) also meant that the system was (initially) sub-optimally used, meaning that pre-existing drift was a contextual factor impacting the use of the system. This drift was referring to moving away from the company's purpose of using the system to better manage its data and processes, and therefore was seen in a negative light.

With regards to the actual use of the system, such drift was seen to occur from the use of systems external to the ERP. This was in accordance with the findings from Multiyork, where the same reason (use of external systems) was also interpreted as a source of drift. In Chubb Fire however, the visibility offered by the system, as well as the access profiles that could be defined in the system, were observed factors additional to the ones observed at Multiyork, which could result in control from the use of the system.

The next section examines the third company researched, NTL. Similarly to the companies of Multiyork and Chubb Fire, NTL was examined in a limited fashion (with only a few interviews). However, the results offer insights into the interviewed persons' perception of the ERP system as well as helping to refine the overall conceptualisation of ERP use presented in section 6.2.

4.5. NTL

4.5.1. Company background

NTL has recently merged with Virgin Mobile in the UK to form Virgin Media, and a couple of years before that they also merged with their rivals, Telewest. At the time of the interviews however, NTL was a US corporation, with their corporate headquarters in New York and their operational headquarters in Hook, Hampshire, UK. Their operational headquarters in Hook were visited as part of this research, in order to carry out the required interviews.

At the time of the interviews NTL was one of the leading providers of broadband, digital television, telephony, content and communications services in the UK, reaching over 50% of UK homes and 85% of UK businesses. The company was spread over four divisions: NTL Home, NTL Business, NTL Carrier, and NTL Ireland. It had three million business customers in the UK, with a large number coming from the public sector.

Having overcome bankruptcy in the US in 2003, NTL needed to be restructured, to implement strong financial controls. The ERP system was seen to play a big role towards this and is described next, together with the interviewees' view on it.

4.5.2. ERP system and interviewees' view

At the time of the interviews NTL was using the Oracle version 11 ERP for the financials part, mainly for accounts payable and accounts receivable. They were also using Oracle around absolute inventorying and stock write-offs. For their HR requirements NTL was using the PeopleSoft ERP system. The Oracle and the PeopleSoft systems did not communicate with each other. For billing they had a bespoke system built for them called "Harmony", the purpose of which was to integrate data from all the different billing systems from 32 companies that NTL had bought in the past. The resulting system was yet another standalone system.

However, although different systems had to be used in many areas in NTL, it was also mentioned that if they had a single platform, they would not be able to afford to keep changing it all the time, in order to keep pace with the changes (mergers, acquisitions, etc) that took place in NTL. Even simple upgrades to the ERP were seen to carry a huge financial cost through business interruption and risk, becoming a barrier to the changes that NTL was continuously undergoing:

In NTL we use this terminology of enablers and blockers, what's a business blocker and what's a business enabler, and a system needs to be an enabler for you to be able to do things, and probably from a financial point of view a blocker is trying to stop you from doing things you shouldn't be doing. But really you are looking for sort of enablers. The danger you run into is that when you end up with a system that has the complete and utter control of the whole business and you want to go in another direction, I mean, you become system restrained. The system then becomes a blocker rather than an enabler. (Supply Chain Manager 2)

The Oracle system was mainly discussed during the interviews. This was seen to have a facilitative rather than a strategic role in NTL. Although details on the implementation of Oracle and its implications were not available from the interviews carried out in NTL, the interviewees viewed the Oracle system as inflexible and difficult to work with. However, the system was seen to be good at providing financial control.

Before discussing the actual use of the system from the interviews carried out in NTL, the next section describes the contextual factors impacting the use of the ERP system (Oracle).

4.5.3. Contextual factors impacting ERP use: control and drift

NTL, because of its nature and the state of the technological sector where it belonged, was initially at a state of drift. It was expanding rapidly, engaging in mergers, sell-offs and acquisitions, and as a result there was no set direction on where the company was going. The result was that a lot of money was being lost, as it was very difficult to keep account of all of NTL's activities and the way the money was being spent.

By installing the Finance module of Oracle the company wanted to add control over its operations and the way money was spent. However, it was mentioned that too much (non-financial) control would not be good in this case, as the company was still expanding and wanted the flexibility to do so. Having an ERP system with fixed business processes and procedures was then seen to be against the company's intentions of expanding. This implied that the company was willing to allow for a degree of drift to occur, in contrast to the rigid control that they deemed an integrative ERP system would impose on them. As such, only the Financials module from the Oracle suite of applications was installed. In a "best-of-breed" approach, the HR functionality was then covered by the PeopleSoft ERP system, which did not communicate with Oracle. Although the "best-of-breed" approach was seen to meet the company's expansion goals, it was also a great frustration for

managers and users of the system, as they could not obtain the information that they wanted all in one system, but had to use different separate systems for their tasks.

Having discussed the contextual factors impacting on ERP use, the next section discusses the actual use of the system (Oracle) and the consequences of this use.

4.5.4. Use of ERP and consequences

4.5.4.1 Access profiles

As in the other companies examined, NTL also had various access profiles defined in the system for its users. Those profiles constrained access to data and operations in the system. Part of those profiles was also authorisation levels for the handling of financial data in Oracle. These authorisation levels defined upper limits of financial transactions for different types of users. In NTL those authorisation levels were seen to be very strict, with very low values of financial transactions allocated to most individuals. However, this was deemed to be necessary, as NTL had serious financial problems in the past, and therefore the installation of the Oracle system was seen as good control of what each individual was spending, so that money could be better accounted for.

Although the interviewees at NTL viewed the ERP system (Oracle) as removing any sort of empowerment from its users, this was mentioned to be compensated by the increase in control (through the access profiles), which was very desirable from a financial point of view in NTL:

I'll go as far as say, the only thing that an ERP is doing, is remove any empowerment whatsoever. I am not saying that's a bad thing, because what you are doing is actually put in controls in place... Empowerment basically means, can I make a decision. The answer is no, the decisions are being pre-made for you. You will not or you cannot bug those roles. If you are talking from a financial point of view, absolutely the right thing to do. (Supply Chain Manager 1)

The next section describes the use of systems outside Oracle, as exemplified with the use of Excel.

4.5.4.2 Use of other systems

Excel was mentioned to be the most useful tool that NTL employees were using, especially for analysis, budgeting and planning. The functionality of the Oracle system in general was seen as quite cumbersome to use, and therefore Excel was preferred, as it was considered to be much more flexible than Oracle, providing users with the information that they wanted.

The reporting functionality of Oracle was also seen as quite poor, as the system gave users a set of standard reports, which did not reflect the needs of the users. As a result, Excel had to be used to produce meaningful reports. For example, if some Key Performance Indicators (KPIs) were to be used to examine the sales information of the company in a current period, Oracle would produce a long list of all relevant financial transactions, which could be many pages long. This would not be in a format suitable to be shown to management, but rather some summary figures would have to be produced, in a layout suitable to be shown to management. In that case, individual reports could be written in Oracle to produce the required results in the required format, but this would be a costly way of doing it. In addition, those reports would have to be rewritten every time the system was upgraded.

A cheaper, and the chosen alternative was therefore to generate those reports in Excel, producing the summary data that was needed, in the format that was needed. Similarly to Chubb Fire however, this use of Excel as an external system that was not under any access controls, meant that drift could occur by users manually (intentionally or unintentionally) changing data in Excel (e.g. in order to present a better picture of the company).

The next sections carry out the analysis and discussion of ERP use at NTL, based on the presentation so far.

4.5.5. Analysis and discussion

4.5.5.1 Machine agency

Although NTL had many systems comprising ERP functionality in a “best-of-breed” approach, the capability of the Oracle Financials module to set different authorisation levels (as part of access profiles) for the amount of financial data that different classes of users could handle in the system was seen to be a good mechanism of controlling what users were allowed to spend.

On the other hand, employing a “best-of-breed” approach for ERP functionalities which did not communicate with each other meant that drift could occur as the data in one system did not correspond to data in the other system, and there was no

interface written between the different systems, such as the Oracle system and the PeopleSoft system. Similarly to the case of Chubb Fire, the reporting functionality of the ERP system (Oracle) at NTL was also seen to be inadequate, in that it did not produce reports of the required format and granularity, resulting in the need to use Excel.

The table below summarizes the perceived technological affordance of the ERP systems at NTL. The corresponding codes from the second pass of coding are shown in brackets.

Table 14: Technology Affordance (Machine Agency) of ERP system at NTL

Technology Affordance (Machine Agency)	Result (Control/Drift)
Not producing adequate reports	Drift (Use of external systems)
Not being able to integrate all billing data from different companies NTL acquired	Drift (Use of external systems)
Allowing authorisation levels for financial amounts	Control (Access profiles)

4.5.5.2 Human agency

The perceived lack of producing adequate reports in Oracle meant that users had to resort to Excel to produce those reports. As Excel did not fall under the access restrictions imposed by Oracle however, this meant that users could manipulate the relevant data if they wanted, resulting in drift from the company's intention of using the ERP system (Oracle) to better manage its finances.

In addition, use of other systems such as Harmony (which was used to integrate billing data from companies acquired by NTL), meant that information in the ERP system (Oracle) did not reflect what data was held in the other systems. As such, this could be seen as an instance of drift from the company's intention of using the ERP systems to better manage its financial transactions. This was especially the case of Harmony not communicating with Oracle, meaning that the billing information that users input into Harmony did not get reflected in the financials module that was installed from Oracle.

In other cases however, especially in the Financials part of Oracle, users could only handle financial data (such as invoice amounts) up to the level they were assigned to. This served to increase control over the way the company was managing its data and processes.

The mentioned examples of human agency at NTL are summarized in the table below (with codes from the second pass of coding in brackets):

Table 15: Human Agency of ERP users at NTL

Human Agency	Results (Control/Drift)
Users having to use Excel to produce adequate reports	Drift (Use of external systems)
Users having to use Harmony to access billing information from companies that NTL acquired	Drift (Use of external systems)
Users having to adhere to strict authorisation levels to better manage spending	Control (Access profiles)

Having described instances of human and machine agency regarding ERP use at NTL, the next section describes the interplay between the two types of agency.

4.5.5.3 Interplay between human and machine agencies

The interplay between machine and human agency can again be seen by the dependency of user actions on the capabilities of the system. Similarly to Chubb Fire, in NTL only uni-directionality was observed, in terms of machine agency impacting on human agency. With this in mind, examples of the interplay between machine and human agency found at NTL are shown in the table below:

Table 16: Interplay between human and machine agencies at NTL

Machine Agency	Human Agency
Not producing adequate reports (Drift)	Users having to use Excel to produce adequate reports (Drift)
Not being able to integrate all billing data from different companies that NTL acquired (Drift)	Users having to use Harmony to access billing information from companies that NTL acquired (Drift)
Allowing authorisation levels for financial amounts (Control)	Users having to adhere to strict authorisation levels to better manage spending (Control)

4.5.5.4 Conceptualisation of ERP use

As has been mentioned, NTL installed the Financials module of Oracle in order to better control its financial data and reduce inefficient spending. On the other hand, the company recognized that too much control would be detrimental on its expansion plans, therefore control was limited only to some financial processes. As such, the company was willing to let a certain degree of drift to occur by not fully integrating ERP functionalities, in order to be able to remain flexible with its expansion plans.

From the limited collected data regarding ERP use in NTL, control was seen to be implemented with authorisation levels (as part of system access profiles) for financial data. On the other hand, drift was occurring from the use of other systems such as Excel and Harmony. The conceptualisation of ERP use in NTL and its interrelationship with control and drift is shown in the figure below.

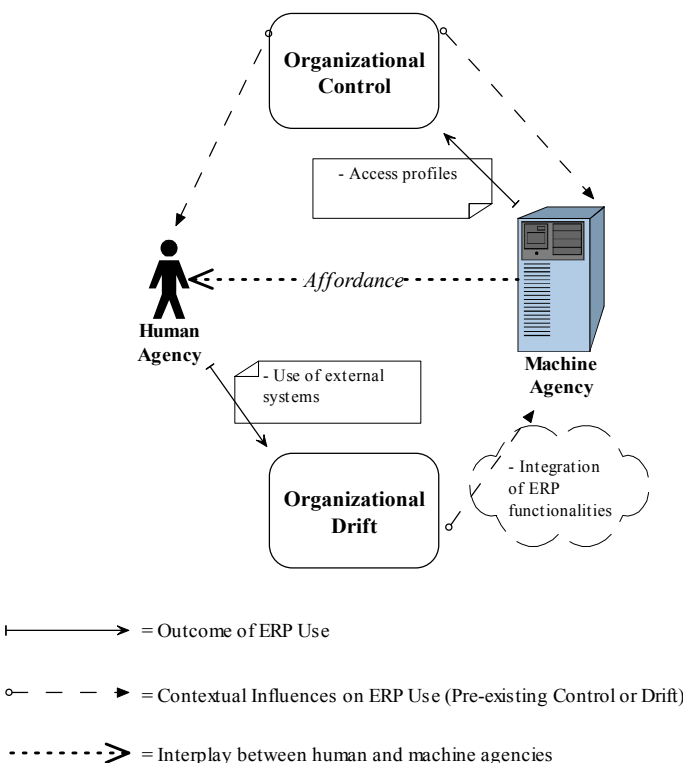


Figure 11: Conceptualisation of ERP use at NTL

4.5.6. Summary of findings and knowledge added

Similar to the company of Chubb Fire, access profiles were observed to be contributing to organizational control arising from the use of the ERP system. In the same manner as Chubb Fire and Multiyork, the use of systems external to the ERP was then interpreted as conducive to drift from the ideal of using the ERP system to efficiently manage the company’s operations.

The particular knowledge that was added from NTL and which was not observed in Chubb Fire and Multiyork, was that NTL purposefully did not want to integrate all of its processes under one system. The company realised the potential of using the ERP to enhance control over its operations, but on the other hand it also realised the potential danger to its business by over-integration. The particular contextual factor in the form of pre-existing drift was then that the integration of ERP functionalities was minimal. This form of calculated and accepted drift from using one overarching system for managing the company’s operations then impacted ERP use, in term of the functionalities afforded by the different systems used in NTL.

The next section presents the fourth company examined in this research, Reuters. This company together with the already presented companies of Multiyork, Chubb Fire and NTL, helped focus the research that was carried out more in-depth in the main case study of Alstom.

4.6. Reuters

4.6.1. Company background

Reuters was founded in London in 1851, and is a global information company providing information tailored for the financial services, media and corporate markets. Although Reuters is best known as the world's largest international multimedia news agency (employing 2,300 editorial staff, journalists, photographers and camera operators in 196 bureaus serving approximately 130 countries), more than 90% of its revenue derives from its financial services business. Around 330,000 financial market professionals working in the equities, fixed income, foreign exchange, money, commodities and energy markets around the world use Reuters products. Reuters employs approximately 15,300 staff in total, in 89 countries.

4.6.2. ERP system

At the time of the interviews Reuters had the Oracle 11i ERP system installed, used for the modules of Finance (accounts receivables, payables, general ledger, fixed assets, and purchasing) and HR. In addition, the Oracle's learning module was also installed, which allowed booking of training courses online, requesting training, and managing the logistics around training.

Users of the Oracle Financial Applications in Reuters were named as Core Application users, whereas users of the HR applications were named as Self-Service users. The latter were essentially not part of the finance function, and they transacted in the system without access to its full capabilities, but mainly got involved in maintaining and updating their personal HR records, or raising their expenses or purchase requests in the system. There were around 6,000 self-service users worldwide. Those users could also book training courses in the Oracle system through the e-learning module. Core application users on the other hand were users of the financial applications, numbering less than 1,000 worldwide.

The next section describes the implementation history of the installation of Oracle at Reuters, including the business need for the ERP system and the level of integration of ERP functionalities.

4.6.3. Implementation history

The design of the ERP system took place between 2000 and 2001, and Reuters first went live in 2001, with the implementation finishing by the end of 2003. The business need for the installation of Oracle is described below.

4.6.3.1 Business need

Reuters had a number of different financial systems, dotted around the world. As the company grew very quickly in the 1980s and 1990s, the individual business units within the countries built up their own infrastructure, which included the systems and the processes that they used to support their business. However, there were also some common elements amongst the various businesses. For example, there was the Oracle Financials module installed in a large number of countries, although the corresponding installations in each country did not communicate with each other.

In the middle of 1998 some things happened that were the impetus for the implementation of the ERP system worldwide in Reuters. One was that the IT community realised that it was very expensive and time-consuming to manage all of these systems independently. This meant that if they wanted to roll out new versions for applications, they had to do it for each country where the application was installed. So there was the need to try and consolidate all of the different applications into one database globally, as that would be cheaper and easier to maintain, and the associated costs would be brought down.

At the same time, the business community that was being served by these systems, i.e. the finance community at Reuters, were having similar thoughts about consolidating their own operations and reducing costs. So they started to think about reshaping themselves, to take finance functions out of all of the different countries and consolidate them.

These two concepts from the finance and the IT community then came joined together in a large transformation program which included the installation of the Oracle ERP system worldwide. This was seen as a way of centralising many of the administrative functions that were going on in the company, and so supporting the strategy to reduce the costs in the business.

Reuters was in fact one of the first instances of a global implementation of Oracle. Reuters was quite unusual in this case, in the sense that it was a very homogenous business across its worldwide operations. It was the same product (financial information mainly) being sold into the same types of customers, globally. In that sense it was much easier to have a global instance with a single platform. It was

also more appropriate than it might be for another company, which was not as homogeneous as Oracle.

The next section describes the level of integration of the functionalities offered by the ERP system, in particular looking at the payroll functionality.

4.6.3.2 Level of integration of ERP functionalities

When the Financials module of Oracle was first installed at Reuters, this also included the Payroll functionality. However, this caused other parts of the system to crash every time upgrades were carried out on it. As a result, the payroll had to be dropped from the system and outsourced to an external company. This was also facilitated by the fact that it was quite easy to write an interface that would take data from Oracle and output it into a flat file, to be used by the external company for processing. This processing could include calculations of e.g. how much overtime had to be paid, how much basic salary, national insurance, taxes, deductions, etc.

Payroll was in fact seen as a classic job that could be outsourced, as one did not need that expertise in a company, and did not have to manage it. As such, although it was mentioned that having one system that would do everything could be advantageous, there could be cases when full integration could also have disadvantages:

Sometimes, there are terrific advantages not being integrated. You know, you've got to pick your points of integration, and your points of non-integration. And there are points where it's actually advantageous not to integrate. Like, we literally cancelled the Oracle Payroll, and outsourced the whole thing. (Cash Management and Treasury Process Director)

Having described the implementation of Oracle at Reuters, the next section discusses the implications of the implementation.

4.6.4. Implications of implementation

4.6.4.1 Business reorganization

The implementation of Oracle at Reuters was based on a single database that served all of the countries where Reuters had a presence. This was located in London, as Figure 12 below shows. The implementation of Oracle also resulted in the creation of Business Service Centres around the world. There was one in the

US, one in the UK, one in Holland, and one in Singapore. Self-service users interfaced with the HR and e-learning applications via their corresponding Business Service Centre, whereas core application users used the Financials applications by connecting directly to the database in London. Each Business Service Centre was also responsible for the running of Oracle in a number of countries, and the communication with the other Business Service Centres. Before the introduction of Oracle such services were more decentralised, with each location where Reuters had a presence having their own responsibility for their systems and processes.

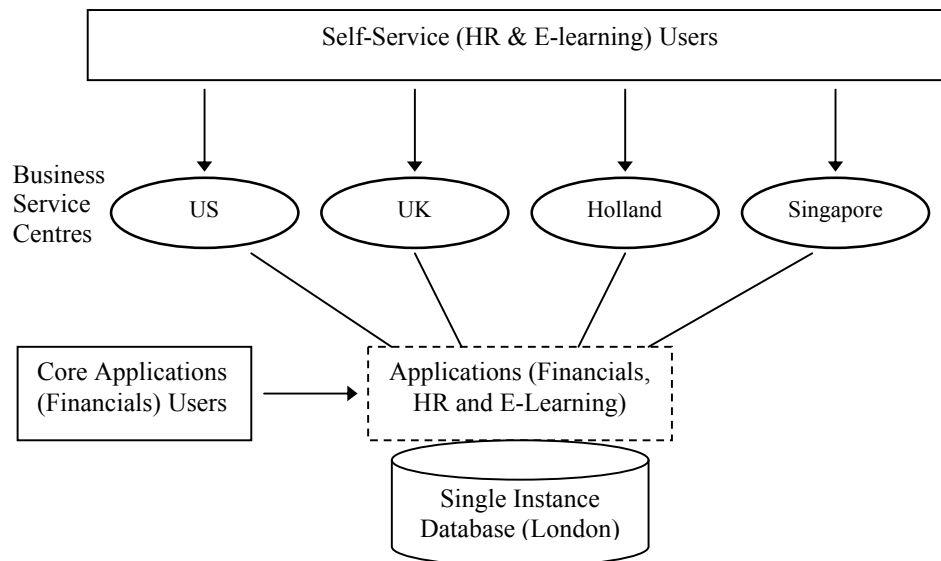


Figure 12: Business Organization at Reuters

The next section discusses the view of the ERP system in Reuters by its users.

4.6.4.2 View of ERP

The interviewees at Reuters were mostly happy with the ERP system. It was mentioned that most of the problems with the system that occurred at Reuters were due to the initial implementation, and the way the system was configured, according to the understanding of the complex user needs. Even though there might have been some problems with its use directly after the initial implementation, the system was continually updated to match the user needs as closely as possible. As a result, two years after the initial implementation, at the time of the interviews, the system was seen to be much better than directly after the implementation finished.

The next section describes the standardisation that was offered by the ERP system at Reuters.

4.6.4.3 Standardisation

The use of a single instance of Oracle, as well as a global template of financial processes meant that Reuters effectively standardised, wherever possible, every single financial process across the world. This meant that for example how one processed a fixed asset in the UK was identical to how one processed a fixed asset in Singapore. It would be the same series of steps in all cases. Certain regions would have certain differences, as a result primarily of local legislation, or interfaces with third parties, which would necessitate doing something different in that particular region. Nevertheless, all those variations were controlled, in the sense that they were recognised as a variation, and codified within the global financial templates as a recognised variation.

Similarly to Chubb Fire, the implementation of the ERP system at Reuters also facilitated compliance with SOX legislation, as the section below indicates.

4.6.4.4 Compliance with SOX legislation

As Reuters was listed in the US stock exchange, it was subject to the Sarbanes-Oxley (SOX) act mandates. From this perspective, SOX was applicable company-wide, with every single organization within Reuters having to comply with it. The purpose of SOX was basically deeply evaluating controls, in a rather bureaucratic fashion. From a business point of view however, SOX was seen mainly as a burden, being too inflexible and rigid.

From an Oracle system perspective, there were some processes in place, which were subject to SOX controls. Those included for example the cash-to-pay and order-to-cash processes. For other processes, such as the record-to-report and fixed assets processes, the controls included authorisation and approval controls. Those controls took place outside of the Oracle system. In that sense the relevant data had to be approved and authorised by human beings prior to its entry into Oracle.

A particular example of the application of SOX controls in Oracle would then be whenever a manual general entry was entered into the general ledger. That manual general entry had to be supported by relevant supporting documentation (such as scans of invoices). The supporting documentation had to be attached to the general entry, which meant that at any point in time, when the SOX testers came in, they would be able to examine those.

However, although some SOX controls were supported by the Oracle system, those could still be bypassed, either intentionally or unintentionally. For example, in transactions that required a supporting documentation piece such as in the case of manual entries in the general ledger, the user could neglect to attach the supporting documentation piece, or attach the wrong one. This was possible, as there was

nothing in the system that forced the user to attach this documentation. Or in the case where the documentation was attached, there was no way for the system to recognize whether this was the right one, as it was a scanned image.

The control in this case relied on human intervention, in order for another user to review the transactions and make sure that what was entered was right. Even in those cases, however, and due to a lack of sufficient human resources, this follow-up testing could only be carried out partially. There were transactions with financial values from anything between 1 penny and millions of pounds in the system. Evidently the testers would then concentrate on the higher value transactions, leaving smaller value transactions untested. This meant that money (although not significant) could still be lost in the system through incorrectly entered transactions.

The next section describes the user empowerment that the implementation of Oracle at Reuters brought.

4.6.4.5 User empowerment

The implementation of Oracle at Reuters gave individuals in some cases more power to carry out tasks in the system than was the case before. This was in the HR area of Oracle, where for example, if an employee wanted to change some of his/her employee records, he/she could do that himself/herself. This could involve simple things like changing one's address, or it could include more substantial stuff such as viewing one's training profile and requesting more training. It could also involve the employees entering and monitoring their own expenses in the system, or raising their own requisitions for the purchase of items.

In the past, if for example a user wanted to order some items (such as stationary), he/she would have to request authorisation from his/her manager, and would not be allowed to decide on the particular stationary to be bought. With the introduction of Oracle however, the user could order those items directly in the system without reference to his/her manager, up to level that was assigned to him/her. This was considered an element of empowerment in Reuters. The flipside of it was that managers did not have to do all of those things anymore, or authorise users to do them, as it was all done automatically in the system.

From the presentation so far of the ERP implementation history and its consequences at Reuters, the next section summarizes the contextual factors that could impact the actual use of the system.

4.6.5. Contextual factors impacting ERP use: control and drift

Reuters installed the Oracle ERP system in order to standardize the company's data and have better control of its worldwide processes. The large degree of control through a single global instance of Oracle was supported by the fact that Reuters was very homogeneous as a business worldwide, in terms of the processes related to the financial information that it was selling.

The installation of Oracle at Reuters also facilitated control over compliance with legislation such as SOX. Although some countries had some differences due to legislation and other local requirements, those were documented as variations to the global set of common processes supported by the system.

In addition, it was recognized that it was advantageous not to integrate all of the required business functionalities in one system. As such, the payroll functionality was outsourced to an external company, and this was seen to increase control over the rest of the system. This was because the payroll functionality was not seen as critical to the company's operations, and it caused other areas of the system to crash whenever it was updated. The perceived by the interviewed persons at Reuters empowerment of users to handle their own HR records was also seen as allowing users to have better control over their own data.

Although no drift as a contextual factor impacting ERP use was reported at Reuters, control as a contextual factor could be seen to be impacting the way that the ERP system was used by the employees at Reuters, for example by having to adhere to SOX legislation, or following the standardised procedures in the system. The actual use of the system is described in the next section.

4.6.6. Use of ERP and consequences

4.6.6.1 Access profiles

With regards to the access profiles that specified which types of users had access to different types of information in the system, it could happen that those controls were either too strict, or too lax. In this sense, there were two ways by which those access controls could be changed: The first was to redefine what a particular access level allowed a person to do, and the second was that an individual could be given a less or more open type of user access. In general however, the system controls in Oracle implemented through access profiles were seen to be quite strict at Reuters, making it difficult to bypass them:

In terms of bypassing controls, the only ways to bypass a control are either to be given somebody else's password, or to do it in cahoots with somebody else. (Cash Management and Treasury Process Director)

Part of the access profiles of the users also defined upper limits for goods that could be bought by each employee, without needing authorisation from his/her manager. Self-service users for example could use their approval limits to buy items for their work that they needed (mainly stationary for office use such as pens, paper, etc). Different limits on the amount of goods an employee could order were set for each country, as for example £50 could be a reasonable amount in the UK, but quite high in some of the Asian or African countries where Reuters operated. This capability of the system to allow users to buy things up to a certain limit had mixed reactions from the managers:

Some people throw up their hands in horror to the prospect of people being able to buy anything without reference to their manager, and some people love that. Because managers don't want to be approving a £5 purchase order, a £15 expense. (Business Centre IS Manager)

The next section presents the way the reporting requirements were handled at Reuters.

4.6.6.2 Reporting

Most reports from Oracle in Reuters were produced with the use of Business Objects, an add-on to Oracle. Business Objects was seen to be an adequate tool for producing reports, as users could use it to build their own reports, selecting from a wide range of fields, whereas this could not be done directly in Oracle.

However, it was mentioned that with some more complex reports in terms of layout and functionality, it would be better to pull out the information from Oracle in an intermediate type, potentially of a CSV (comma-separated values) type, and then import it into a system that was better at reporting than Business Objects. Although Excel could be a potential candidate for this, it was also seen as a not very efficient way of producing reports. Another tool called Mira was in fact used for this purpose. This was actually based on Excel, but also involving a database beneath and additional functionality.

The reason for actually using Mira instead of directly using Oracle or Business Objects was that Oracle's reporting functionality was not seen to be very good, and also management in each country had their own requirements in terms of the way that information from the system was presented. This meant that in effect Oracle was used to dice all the information in the system according to criteria given by the user. The actual reconstruction and summarization of that information in order to

see, for example, what was being spent on a particular product, or how much revenue accrued from a particular country, was done in Mira. This also made it more flexible to manipulate the data. This was done once a month in most cases, at the point where the accounting books for the relevant month were to be closed. The data was downloaded from Oracle to Mira at this point, and reported against that.

In addition to the use of Mira which was external to Oracle and was used for reporting, there were also other systems that were used instead of Oracle. Those are described in the section below.

4.6.6.3 Use of other systems

Another area except reporting where systems outside Oracle had to be used was in the case of providing services to customers, and as a result having to order relevant items from the suppliers of Reuters. Reuters' customers in this case would be various financial institutions, banks, brokerages, and insurance companies. They would order from Reuters feeds of information, for example all the foreign exchange information needed to do their job.

In this case the customer would place an order with Reuters, and a salesman would go and visit the customer, and agree what products were wanted. This information would then be entered into a system separate from Oracle, in particular into a Siebel database, which was used before the introduction of Oracle, and was still in use after the implementation of Oracle. This meant that a sales administrator would type the order in Siebel, and then the system would start a number of activities to enable the service to be provided to the customer.

However, in case a purchase order from the part of Reuters was needed to be placed with their own suppliers to enable to fulfil the order from the customer, the user would then have to go out of the Siebel system and into Oracle, in order to create the relevant purchase order. This had to be done manually, which meant that typing mistakes or user errors could occur when copying the relevant details of the items to be ordered from the Siebel into the Oracle system. This was recognized as a vulnerability, and an automatic link was envisaged to be created between Siebel and Oracle.

The next section looks at human control enabled by the ERP system during its use.

4.6.6.4 System-enabled human control

Human control (mostly managerial) enabled by the ERP system was reported to arise from the balance sheet reconciliation process, the process of payments with BACS, as well as the buying processes. Those are described in the sections below.

4.6.6.4.1. Balance sheet reconciliation process

In some cases, human (managerial) control was necessary, although the relevant processes were carried out in the system. This was for example the case with the balance sheet reconciliation process. The review of the reconciliation was in fact a very important step to carry out, instead of relying on the fact that the reconciliation had been done by an individual. Somebody in a position of authority then had to manually review the reconciliation that was done in the system, to make sure that it was meaningful. The system in fact had the capability to notify the relevant person in position of authority to go in and review the reconciliation as soon as it was ready to be examined, which was an important control step of the process.

4.6.6.4.2. Payments with BACS

Managerial control using data from the system was also needed in the case of a payment batch needing to be prepared for payment with BACS (Bank Automated Clearing System). When the process was originally set up, the plan was that all required authorisation for the payments would be in the Oracle system, and the system would control that. However, this did not materialise, as it was deemed better to send an e-mail with an authorisation by the relevant person, saying that the payment was right and could go ahead. This was a procedural control outside the technical controls in the system, but using data (payment information) from the system. It was seen as a cumbersome but necessary process, as human intervention was deemed necessary for outgoing payments.

4.6.6.4.3. Buying

Self-service users working with the HR applications could use the capabilities of the system to buy items they needed (mostly office stationary). In most countries in this case there was a list of catalogue items in the system that the company had already decided they could be bought by employees of Reuters.

If any receipts were required in order to approve certain expenses for the buying of those or other items, those were sent offline to the finance department separately. The expenses were paid before the receipts had been received, but there was a check in the system that dictated that if the same person submitted another expense claim without previously submitting the receipts from the previous expense, then the new expense claim would go on hold until the receipts from the previous claim were received.

There also needed to be some controls to make sure that what users ordered was for their business needs, and not for their personal use. The primary control in this case was that if someone ordered items from a pre-defined catalogue, then the nature of those items meant that they could only be used for business purposes. When anything was ordered that was not in a pre-defined catalogue, then the process would stop there, and a manager would have to review what had been ordered. There was a control element there, in that the manager would then have to consider whether it was appropriate for the person to be buying the things he/she ordered. This was if it was below the self-approval limit of the individual; if it was above, in any case the user's manager would see what the user was buying, and could reject it at that point.

There were also some extra elements of control that were put around this buying process, those control elements also involving human (managerial) intervention. For example, certain items in the system were flagged as always needing approval for buying (e.g. mobile phones). In addition, certain types of expenses had to be sent not just to managers for approval, but also to technical groups to approve the purchase from a technical compliance perspective. An example of that was software. For this purpose, the IT department was responsible for reviewing every single software request from around the world, regardless of its value. This was needed in order to determine whether Reuters had the correct licensing agreement with the relevant suppliers to allow the use of the software inside the company's walls.

Having presented the ERP system, its implementation and use at Reuters, the next section analyzes and discusses this data based on the concepts of human and machine agency, as well as the disembedding and reembedding of human actions, before presenting the conceptualisation to account for ERP use at Reuters.

4.6.7. Analysis and discussion

4.6.7.1 Machine agency

The instances of machine agency of the ERP system found at Reuters and described in the previous sections are summarized in the table below. The way control was enabled or drift was propagated with the relevant capabilities of the ERP system are also discussed as comments. The relevant important codes from the second pass of coding (presented in Figure 7) are also included in brackets after the outcome of control or drift from technological affordance. These codes are used to develop the conceptualisation in section 4.6.7.5 to account for ERP use at Reuters.

Table 17: Technology Affordance (Machine Agency) of ERP system at Reuters

Technology Affordance (Machine Agency)	Result (Control/Drift)	Comments
Allowing creation of flat files with payroll info	Control (System Properties)	Control of what information is sent to the external company where payroll is outsourced
Allowing creation of a single global template for financial processes	Control (System Properties)	By standardizing financial processes worldwide the company gains control over relevant operations
Allowing setting of limits (authorisation levels) for buying goods	Control (Access Profiles)	Company can better control up to what level each individual is allowed to buy
When reconciliation process finished by employee message is sent to manager to review it	Control (System check, Visibility)	The reconciliation financial process is better controlled by requiring the manager to review it
System requiring user to confirm goods or services have been received	Control (System check)	System check serving as control that goods or services were indeed received
System check that receipts from previous expenses have been sent to the finance department	Control (System check)	Receipts could be sent by the user after buying goods. Before the next purchase order could be authorised by the system however, the receipts from the previous claim would have to be indicated as “received” by the finance department.
Checking whether items to be bought are from pre-defined catalogues	Control (System check)	System check that what users are buying is acceptable by belonging in pre-defined catalogues
Allowing marking of items in catalogues as always needing approval for buying	Control (System Properties)	Making sure that manager always approves certain items to be bought
Allowing authorisation of outgoing BACS payments in the system	Control (System Properties)	Controlling that outgoing payments that need authorisation are authorised by a superior
Not communicating with Siebel database where customer orders are held	Drift (Use of external systems)	The company drifted from its ideal of data standardisation by using a Siebel database for the inputting of customer orders, which existed before the introduction of Oracle
System not being able to recognize attached supporting documentation pieces (e.g. scanned images)	Drift (System Properties)	Drift from intention of automatically controlling supporting documentation pieces to match them with financial values from expenses and invoices
Not being able to produce adequate reports	Drift (Use of external systems)	Drift from intention of using single instance of Oracle to manage reporting requirements as well

The next section presents instances of human agency identified from the examination of Reuters.

4.6.7.2 Human agency

Examples of human agency with regards to ERP use at Reuters are summarized in the table below, together with an explanation of the way human actions impacted

on control and drift in the organization. Relevant codes from the second pass of coding are also shown in brackets.

Table 18: Human Agency of ERP users at Reuters

Human Agency	Result (Control/Drift)	Comments
Users extracting info from Oracle HR for creation of payroll files	Control (System Properties)	Users can send payroll files to outsourced company
Users using one set of financial processes worldwide	Control (System Properties)	Control that users are following standardized processes
Administrators setting different limits (authorisation levels) for each country for the buying of items	Control (Access profiles)	Control that authorisation limits for buying items in each country are set according to national characteristics
Manager reviewing reconciliation	Control (Visibility)	Control by viewing other users' (subordinates') actions in the system
User confirming whether goods or services have been received or not	Control (System check)	Control that ordered goods or services have indeed been received
Users sending receipts from the buying of items to the finance department, the latter indicating in the system that those receipts have been received.	Control (System check)	Receipts could be sent by the user after buying goods. Before the next requisition order could be authorised by the system however, the receipts from the previous claim would have to be indicated as "received" by the finance department
Managers manually checking items to be bought if they are not from pre-defined catalogues	Control (Working outside the system)	Control outside the system if items to be bought are not from pre-defined catalogues in the system
Managers/technical groups manually reviewing requests for buying items marked as always needing approval	Control (Working outside the system)	Control outside the system if items to be bought are flagged as always needing approval in the system
Manually authorising outgoing BACS payments with e-mails	Control (Working outside the system) / Drift (Use of external systems)	Control by managers authorizing payment. Drift by using system external to the ERP (e-mail) to do so, which could result in relevant authorisations not being input automatically into the ERP system
Supplier orders have to be entered manually into Oracle by looking at the information in Siebel	Drift (Use of external systems)	Mistakes and data inconsistencies in the processes of manually transferring data could result in drift from the company's ideal of data control
Users having to manually inspect transactions for compliance to supporting documentation, and only concentrate on higher-value ones	Drift (Working outside the system)	Drift by not accounting for all transactions in the system for compliance to supporting documentation
Using another database (Mira) to manipulate data and produce reports	Drift (Use of external systems)	Drift by using a system external to the ERP (Mira database), not falling under the same access controls as the ERP

Having analyzed the findings from Reuters in terms of machine and human agency, the next section describes the interplay between the two types of agency.

4.6.7.3 Interplay between human and machine agencies

The interplay between machine and human agency as this was evidenced from the examination of Reuters is shown in the table below. The capabilities of the machine in this case in terms of the actions it enabled or constrained (the machine agency), impacted on the actions that users could take in the system. On the other hand, the actions that users took in the system reflected on the system as well. For example, the way that the system was configured by human agents (e.g. regarding the different authorisation levels for each country, and the different access profiles) reflected on how the system functioned in order to provide the required controls. The information that was entered in the system by human actors was also very important in determining what actions the system could then take. For example, if purchase orders were not approved by a human agent (e.g. a manager), the system could then not continue with further processing the relevant purchase.

In the table below the impact of machine and human agencies on control and drift is also shown, as this was reported in Table 17 and Table 18.

Table 19: Interplay between human and machine agencies at Reuters

Machine Agency	Human Agency
Allowing creation of flat files with payroll info (Control)	Users extracting info from Oracle HR for creation of payroll files (Control)
Allowing creation of a single global template for financial processes (Control)	Users using one set of financial processes worldwide (Control)
Allowing setting of limits (authorisation levels) for buying goods (Control)	Administrators setting different limits (authorisation levels) for each country for the buying of items (Control)
When reconciliation process finished by employee a message is sent to manager to review it (Control)	Manager reviewing reconciliation (Control)
System requiring user to confirm goods or services have been received (Control)	User confirming whether goods or services have been received or not (Control)
System check that receipts from previous expenses have been sent to the finance department (Control)	Users sending receipts from the buying of items to the finance department, the latter indicating in the system that those receipts have been received (Control)
Checking whether items to be bought are from pre-defined catalogues (Control)	Managers manually checking items to be bought if they are not from pre-defined catalogues (Control)
Allowing marking of items in catalogues as always needing approval for buying (Control)	Managers/technical groups manually reviewing requests for buying items marked as always needing approval (Control)
Allowing authorisation of outgoing BACS payments in the system (Control)	Manually authorising outgoing BACS payments with e-mails (Control/Drift)
Not communicating with Siebel database where customer orders are held (Drift)	Supplier orders have to be entered manually into Oracle by looking at the information in Siebel (Drift)

System not being able to recognize attached documentation pieces (Drift)	Users having to manually inspect transactions for compliance to supporting documentation, and only concentrate on higher-value ones (Drift)
Not being able to produce adequate reports (Drift)	Using another database (Mira) to manipulate data and produce reports (Drift)

The next section describes the observed disembedding and reembedding of human actions in the system, as was interpreted from the findings of the interviews at Reuters.

4.6.7.4 Embedding-disembedding of human actions

As Reuters was examined in relatively more detail compared to the companies of Multiyork, Chubb Fire and NTL, instances of the disembedding and (re-) embedding of human actions relative to the use of the ERP system were also observed (albeit to a limited degree). An action of a user in the system in this case meant that it was disembedded from the local context of his/her machine where it was carried out, and became available across all other locations of the company according to the way the system was installed and configured. This action could then be reembedded locally by other users of the system, by using it as the input for their own work. Reported examples of disembedded and reembedded human actions in the system are shown in the table below. The disembedding and reembedding of human actions in the system was facilitated by the workflow that was inscribed in the system, and the single database that enabled monitoring of user actions.

Table 20: Embedded and disembedded human actions at Reuters

Disembedded Human Action	Reembedded Human Action
Reconciliation process marked as finished by employee in the system	Manager reviewing reconciliation in the system
Finance indicating in the system that receipts from a previous expense claim have been received from a claimant	Claimant can raise next claim in the system

Having analyzed the data from Reuters according to the dimensions of machine/human agency and disembedding/reembedding, the next section develops the conceptualisation to account for ERP use at Reuters.

4.6.7.5 Conceptualisation of ERP use

The figure below presents the conceptualisation of the use of the ERP system at Reuters, and its interrelationship with control and drift. Similarly to the other three companies presented previously, the ERP system was installed in response to

certain organizational mandates for control (in this case the need for standardisation and to be able to better respond to legislative requirements such as SOX). As Reuters was in a relatively stable position in the market and its processes and procedures were quite similar across the globe, the company wanted to reduce any drift from differences in its existing processes, and increase control over its operations.

In Reuters users were also seen to be empowered in the HR area of the system, by being able to manage their own HR data and purchases in the system. Reuters also paid particular attention with regards to the degree of integration of ERP functionalities, to account for the ones that were needed internally and the ones that could be outsourced (such as the payroll functionality). Those were interpreted to be contextual factors promoting control over the way the system was used by its users.

As has also been discussed in the other three companies so far, ERP use was characterised by the interrelationship between human actors (users) in the system, and the capabilities of the ERP system (the agency of the system). As relatively more data was collected from Reuters, the human agency in this case was further refined according to the disembedding and reembedding of actions.

As in the case of the previous three companies presented, control was seen to occur from the visibility of other users' actions in the system, the access profiles that specified allowable user actions in the system, and various checks carried out by the system to ensure the consistency of its data and processes. In addition, control at Reuters was also seen to occur because of various properties of the system allowing certain user actions, as well as users (such as managers) working outside the system, e.g. to manually approve balance reconciliations and purchase invoices.

Also similarly to the other companies presented so far, drift was seen to occur from the use of systems outside the ERP, deviating from the company's intention to standardize its data and processes as much as possible. Such external systems in Reuters were the Mira database for reporting needs, and the Siebel database for storing supplier orders. Use of such systems meant that data were not synchronized in Oracle, and needed to be updated manually. Certain system properties such as not being able to recognize supporting documentation pieces and consequently users needing to prioritize corresponding transactions according to their value when manually checking those transactions meant that drift could also occur. This was because some erroneous transactions and corresponding documentation pieces could be left unchecked (and therefore uncontrolled) in the system.

Although limited data were collected to support the disembedding and reembedding of user actions in the system, in the conceptualisation below the disembedding and reembedding of user actions are shown to operate in cycles. This is in order to reflect the workflow inscribed in the system, indicating the chain of

operations carried out by users, with each step in the process affecting other users of the system. A disembedded action by a user in the system meant that it was made available to other users of the system, and the reembedding of this action meant that it could be appropriated by other users.

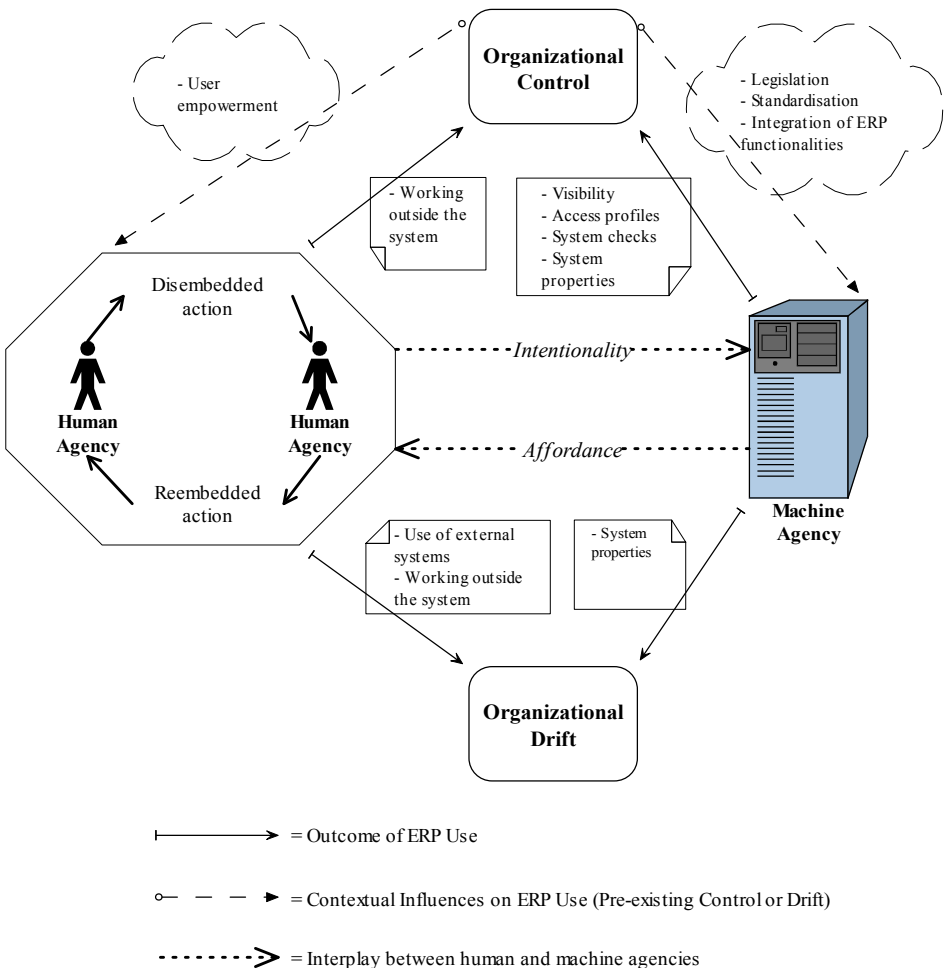


Figure 13: Conceptualisation of ERP use at Reuters

4.6.8. Summary of findings and knowledge added

As has been mentioned, similarly to Chubb Fire, legislation was identified in Reuters as a contextual factor that was an impetus to enhance control through the system with regards to compliance to the particular legislation (in this case SOX). In addition, in Reuters a number of other contextual factors facilitating control over the use of the ERP system were identified. The need for standardisation of the

financial and HR processes was one, as well as the mentioned empowerment of users in the HR area, giving them control over their own HR records.

In addition, whereas NTL purposefully allowed some degree of drift by not fully integrating its processes via a single ERP system, the reverse was true in Reuters. The purpose in this case in Reuters was to increase the integration as much as possible, and this was a contextual factor which was meant to increase control over the use of the ERP system.

With regards to the actual use of the ERP system, similarly to some of the other companies examined, the visibility offered by the system, its access profiles, and various system properties and system checks were seen as conducive to facilitating control through the use of the system. In addition in Reuters in particular, control was also seen to be facilitated by working outside the system but using data from the system, e.g. manually approving purchase orders.

When it came to drift from the use of the ERP system, the use of external systems was a common factor resulting in drift, similar to the other companies examined. In Reuters in particular, certain system properties and working outside the system were also interpreted as being conducive to drift, the latter because of potential errors made while working outside the system.

Having described and analyzed the four companies of Multiyork, Chubb Fire, NTL and Reuters, the next section presents the initial lessons learned, in order to more elaborately formulate the research questions summarized in section 1.4 of this document. This also serves to focus on the examination of the main case study of this research presented in chapter 5.

4.7. Initial Findings and Formulation of Research Questions

As has been mentioned, the research carried out was accomplished mainly with semi-structured interviews, both in the companies presented in this chapter, as well as Alstom presented in chapter 5. Those interviews were more open at the start of the research, in order to give the interviewees freedom to discuss the issues that were most of interest to them, and to be able to develop a more focused agenda and research questions for the research to follow. Although the interviews were adapted to the responses from the interviewees, they tended to become more focused after the initial stages when issues of interest regarding ERP use started to emerge (especially regarding Alstom). Although in this section the development of the research questions is shown to be derived mostly from the examination of the four case studies presented in this chapter, in fact Alstom also played a big role in the development of these research questions. However, in order not to confuse the examination of the in-depth issues in Alstom, only the four companies (without Alstom) are presented here with regards to the development of the research questions, in order to fully concentrate in Alstom in chapter 5.

From the examination of the case study companies presented in this chapter (and also from Alstom which is presented in chapter 5), it became evident that the history of implementation was an important factor in determining the actual use of the ERP system. Reuters for example took a very organized approach to the implementation, carefully identifying business needs, reorganization issues, and the benefits and drawbacks of installing a global ERP system.

Other contextual factors that were important in determining the role and use of the ERP system were also identified. Reuters for example was already standardised as a business worldwide, before the introduction of the ERP system. This made it more straightforward to be able to install and use the ERP system without major problems. NTL on the other hand was constantly involved in organizational changes, and also depended on changes taking place in its industry. As NTL was very much unstable as a business in terms of its operations, a single unified ERP system was seen as not facilitating the company's strategic goals.

Other contextual factors also included legislation, which an ERP system could aid in making sure it was adhered to. This was for example the case with SOX processes that were mentioned at Chubb Fire and Reuters. As some of those processes could be embedded in the ERP system, it was important to make sure that the system was configured correctly to reflect those. The role and use of the ERP system also depended on the correct and adequate training given to its users, as was mentioned by Chubb Fire. Power differentials regarding the ERP system in the case of Chubb Fire, as well as user empowerment and attention to the level of integration of ERP functionalities at Reuters were also important contextual factors

impacting the role and use of the ERP system. Perceived resistance to the system (as mentioned at Chubb Fire) and disintegration of ERP functionalities (at NTL) were then interpreted to be drifting factors affecting the use of the system.

The identified contextual factors impacting on ERP use were classified as pre-existing organizational control or drift in the examination of the case study companies. As has also been mentioned in chapter 2 (Literature Review and Knowledge Gap), although there is a plethora of studies dealing with the success factors for an ERP implementation, there are not any studies which particularly link those with pre-existing control and drift impacting the role and use of the ERP system.

The above considerations led to the formulation of the first research question, which needed to examine internal organizational and external contextual factors that impacted the role and use of the ERP system. As such, the first research question that was formulated was:

First Research Question

What are the key contextual factors (in the form of pre-existing control and drift) that influence the role and use of an ERP system?

Having identified contextual factors influencing the role and use of the ERP system, the discussions of the four companies presented in this chapter (as well as Alstom presented in chapter 5) also included the actual use of the ERP system. The discussion with the interviewees (mostly managers in the four companies presented in this chapter but also many users in the case of Alstom) indicated that the way the system was used had an impact on whether organizational control was promoted or drift was enacted.

Although the system was installed to a larger or lesser degree in the companies examined in order to control their data and operations, the actual use of the system determined the degree to which this control was adhered. Access controls in the system (including authorisation levels regarding the handling of financial data) were mentioned as good control mechanisms in the ERP system. This was similarly the case with various checks for data consistency carried out by the system, as well as the visibility of user actions that the system offered.

On the other hand, it was mentioned that certain system properties and the accuracy of the information input by users in the system played a big part on whether organizational control was implemented or drift was propagated. Use of external systems such as Excel (e.g. for the production of reports) were also mentioned by the interviewees. As those systems did not impose any restrictions on data access and manipulation as the ERP system did, this was interpreted as potential loss of control by the use of such systems.

The above findings on the way the use of the ERP system impacted organizational control and drift were an impetus for the formulation of the second research question. In addition, as has been mentioned in the identified Knowledge Gap (section 2.7), although most of the literature indicates that ERP systems impose stringent controls (e.g. Dillard et al., 2005; Kallinikos, 2004), some argue that those controls can still be bypassed to a certain degree by users (e.g. Boudreau and Robey, 2005). In response to this literature and in recognition of the fact that technology can be shaped by users according to their own practices and the organizational context whether the technology is used (Howcroft et al., 2004), it was deemed important to examine those issues in this research. As has been mentioned in the Knowledge Gap (section 2.7) as well, the link between ERP use, control and drift is not examined in the existing literature on ERP systems. In order to address those points, the second research question was formulated:

Second Research Question

How does the actual use of an ERP system influence organizational control and drift?

As has been mentioned, these two research questions were developed both from the examination of the four case study companies presented in this chapter, as well as Alstom presented in chapter 5. In order to concentrate on the description, analysis and discussion of Alstom as the main case study of this research however, it is presented separately in the next chapter.

5. Main Case Description, Analysis and Discussion

5.1. *Introduction*

This chapter presents the main case study of this research. The presentation follows the same structure as the one followed in the four companies discussed in the previous chapter. In the sections that follow, section 5.2 presents the plan for creating knowledge from the examination of Alstom. Sections 5.3 and 5.4 introduce the company and its ERP system respectively. Sections 5.5 and 5.6 examine the implementation history and the implications of implementation of the ERP system at Alstom respectively. These sections mainly take into consideration the first research question, examining organizational mandates and implementation history as contextual factors determining the role of the ERP system and influencing its use in Alstom. Those results are then summarized in section 5.7 in the form of existing organizational control and drift influencing ERP use. The actual use of the system is discussed in section 5.8, addressing mainly the second research question. The overall results are then analyzed and discussed in section 5.9, while section 5.10 summarizes the overall findings.

5.2. *Plan for Knowledge Creation*

Similar to the four auxiliary case study companies presented in the previous chapter, the analysis and discussion of Alstom in this chapter is based on the concepts of human and machine agencies, as well as the further elaboration of human agency into the disembedding and reembedding of human actions in the system.

The analysis of Alstom is sensitive to the results obtained from the examination of Multiyork, Chubb Fire, NTL and Reuters. In particular, the contextual factors impacting ERP use (such as legislation, training, power differentials, etc) that were found in the four auxiliary companies are also examined in Alstom, together with additional factors that were found to impact ERP use in Alstom in particular. In addition, the factors from ERP use impacting on organizational control or drift that were found in the four auxiliary companies (e.g. data quality, access profiles, system checks and properties, etc) are also examined in Alstom, albeit in a different context and with additional factors found.

The examination of Alstom is also using the sensitizing devices presented in section 2.8 and the resulting coding structure presented in Figure 7. The results from Alstom itself present rich insights regarding aspects of ERP use, including the contextual factors impacting the use of the system (which are categorized in the form of pre-existing control and drift), as well as the factors of ERP use in turn impacting organizational control and drift. The results from Alstom are then used in chapter 6 in order to compare (wherever this is possible, at a high level) all of the companies examined in this research. This plan for knowledge creation is illustrated in the figure below.

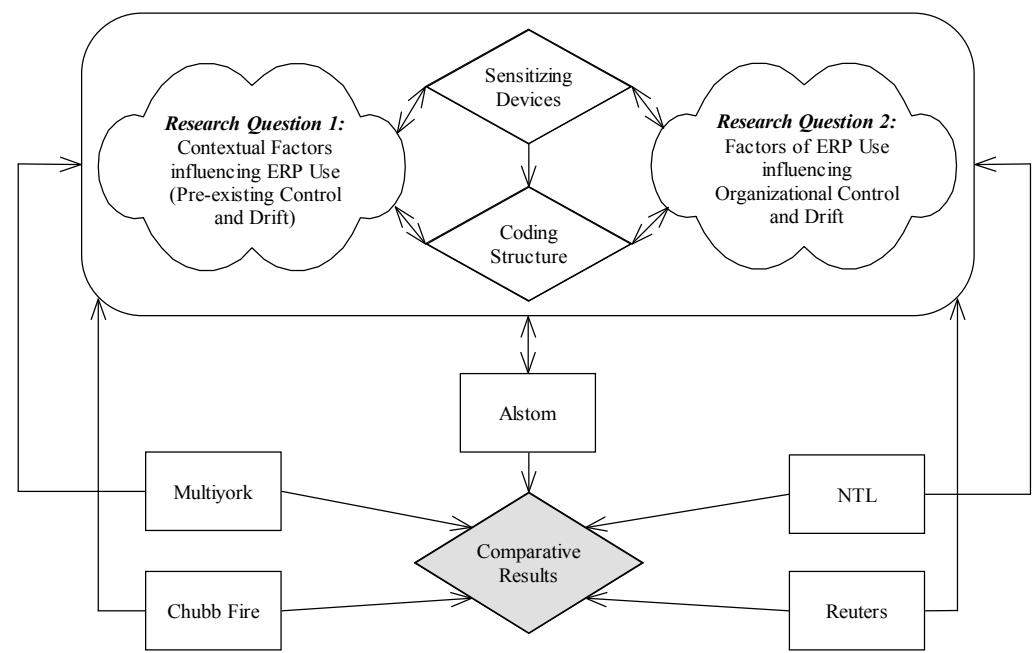


Figure 14: Knowledge creation from the examination of Alstom

The next section starts the presentation of the case study company of Alstom by introducing the company.

5.3. Company Background

Alstom is a world leader in energy and transport infrastructures, being a major worldwide player in equipment and services for power generation and rail transport. It is present in 70 countries, and although its headquarters are in Paris, France, almost 90% of group turnover (totalling around €14 billion) is achieved outside France.

The rail transport division of Alstom in the UK was examined in this research. Alstom's Transport sector employs 24,700 people worldwide, has €5.1 billion in sales, and 19% market share. It operates in 50 countries worldwide, of which 49.1% are in Southern Europe, 27% in Northern Europe, 14.5% in the Americas, and 9% in Asia-Pacific. Their product line consists of 58% rolling stock, 18% train life services, 13.5% information solutions, 5.5% systems, and 5% infrastructure.

In the rail transport sector Alstom is currently the global number one in terms of orders. It supplies rolling stock, transport infrastructure and signalling and maintenance equipment. It develops very high speed trains (more than 300 km/h), such as the French and South Korean TGV, Eurostar and Thalys, as well as high-speed tilting trains (more than 250 km/h). Alstom is also number two worldwide in urban transportation: it provides metro systems around the world (including Paris, London, New York, Washington, Caracas, Singapore, Shanghai, Istanbul and Athens). In addition, Alstom trams have been chosen by more than 20 French cities and numerous others across the globe in Italy, Spain, Ireland, Germany and Australia.

The sites from the Transport sector of Alstom in the UK that were visited for the purposes of this research included Birmingham, Preston, Manchester and Wembley (London). The operational headquarters for the UK operations were located in Birmingham, while train maintenance and repair depots existed in Preston, Manchester and Wembley. At Preston there were also warehouse facilities, serving mainly the depots of the West of England. The ERP system installed at those sites and other locations worldwide is introduced in the next section.

5.4. *ERP System*

At the time of the interviews, the transport section of Alstom was using the SAP R/3 ERP system, version 4.5 in most places where it was installed worldwide, although there were some later versions (4.6) or earlier versions (e.g. 3.1, or even R/2) in some countries. The modules of SAP used in the UK sites examined were Materials Management, Purchasing, Service Management, Finance, Sales & Distribution.

The system was fully installed in the UK, Spain, France, Sweden, Romania, Chile, and the USA. The company was adding more countries to the SAP implementation, with an emphasis on full global deployment in the future. The next section describes the history of implementation of SAP in the UK.

5.5. *Implementation History*

5.5.1. Implementation process

The impetus for installing the ERP system in Alstom was the fact that the company needed an integrated system that would manage its whole business. Before the SAP system, Alstom was using another ERP system (BAAN) at various locations in the UK, as well as a standalone finance system call Omicron.

The implementation in the UK started in June 2000, and finished in January 2002. The data migration (for the financials part) from Omicron to SAP took place in March 2002, and interfaces were also developed from the legacy systems that some UK business units were using into SAP. The BAAN system was not directly switched off, but this was done in phases, as data from BAAN were still being used in some areas.

During the first stages of implementation of the system, there were 4 weeks of intensive testing, trying to examine the processes in SAP and their fit with the existing business processes in Alstom. For this purpose representatives from various departments of Alstom worked together with the SAP experts from the consultancy company that helped to implement the system, Andersen Consulting.

However, although the testing team included representatives from most departments and geographical locations of Alstom, one problem at the billing side (part of finance) of SAP was that nobody in the business was released to help develop it. This was in contrast to other areas, such as the service management and materials management areas, where there were people allocated to help develop SAP, with the result that Alstom acquired considerable knowledge and expertise. That did not happen in the billing area, as it was not possible for the business to release anybody. This consequently meant that the company encountered many problems with the billing functionality of SAP.

The next section describes the creation of an IT department to manage amongst others the SAP system.

5.5.2. IT department and ERP system

Within Alstom there was a central team called ITC (IT Central) responsible for the IT infrastructure in the Transport sector. They resided at the global headquarters of Alstom, in Paris, France. After the introduction of SAP, their responsibilities also included the maintenance of the system worldwide.

Within the UK, a team was created in March 2004 in Birmingham, in order to aid ITC in Paris with regards to the management of Business Processes and Information Systems worldwide. This team was called Business Process and Global Information Systems (BPnGIS). The BPnGIS team's responsibilities included amongst others the installation of new instances of SAP in countries where SAP was not installed, training users, and carrying out modifications to the system according to user requests. Requests for any type of work (modifications, access rights, training, etc) with regards to the system were logged to the BPnGIS team via an intranet-based helpdesk.

The BPnGIS team was completely under the control of ITC in Paris, and for any major work that needed to be done, there always had to be the sanctioning from Paris. In that sense the BPnGIS team, as it was located in the UK, also acted as a link between the requirements of UK users, and the global implementation and configuration of the SAP system that was carried out by the ITC team. Paris therefore had control of the system, while the BPnGIS team had more of a business analyst role, analyzing the business requirements and then feeding this information through to the SAP team in Paris.

Within the sites visited, there were some negative views about the BPnGIS team, as well as the Paris headquarters. As Paris wanted to keep the configuration and use of the ERP system as standard worldwide, it was very hesitant in carrying out updates to it, unless those would affect the majority of countries where SAP was installed. Even in cases where updates were agreed by Paris however, those took a long time to implement according to the users, and this was viewed negatively. Hesitation and delays from ITC also included modifications to paperwork as well, such as SAP manuals.

However, as most users in the UK interfaced with the BPnGIS team directly, and not with Paris, most of the negative criticisms were directed towards the BPnGIS team. This tended to put the BPnGIS team in an awkward position, as they needed sanctioning from Paris to carry out user requests, but Paris was reluctant to give its consent in many matters in order to avoid deviation from standards regarding the configuration and use of SAP. As a result, many users who did not have interaction with Paris blamed the BPnGIS team for being unresponsive to their needs, slow and inefficient. Some times there were tensions between users and the BPnGIS team, as well as between the BPnGIS team and Paris.

In addition, the BPnGIS team claimed that they were also understaffed, with the result that they could not respond very quickly to user requests. This impacted training as well, and one common complaint from most users of the system was that they had not received enough training, and that either they did not understand how the system worked, or could not use it to its full potential. Training itself as

part of the SAP implementation process and afterwards, is discussed more fully in the next section.

5.5.3. Training

Training was mentioned to be needed virtually before going live, otherwise people would not be ready to use the system when it became functional. When Alstom went live with SAP at each of their depots in the UK, they in fact provided a 24-7 helpdesk for 3 weeks, in order to help the users at the depots with any problems they encountered. There were also training materials that users could refer to if needed.

From this experience it was recognised that the company needed to produce process documents on how to carry out various transactions in SAP. As a response to this need, a large number of such documents (around 400) were produced. These documents were held within a database called Prisma, which was accessed via Lotus Notes. Although the search criteria to find a particular document were mentioned to be not very efficient, users also tended to overlook these documents. Instead, they complained about inadequate training.

In order to motivate users to read those documents, they were assigned to user groups in Prisma, with each user group being allocated relevant documents that were of interest to their group (for example, users from the Materials Management team were assigned to the user group for documents relevant to carrying out transactions in the Materials Management area of the system). Whenever a document in the system was added or updated, then the users in the relevant user group would receive an automatic e-mail to inform them of this.

The purpose of having the documents in the Prisma database was as quality and control documents. This was achieved by keeping them in electronic format rather than hard copy, and automatically e-mailing users when any document was changed. When users needed those documents, then they could just download the latest version from Lotus Notes, instead of having an outdated hard copy version. However, this did not work either, as users tended to ignore the e-mails they received, and did not access the relevant documents in Prisma at all.

The production and maintenance of the Prisma documents, as well as the organization and running of training was the responsibility of the BPnGIS team. Given the large number of people that had to be trained, and the insufficient training facilities available, there were some people who were trained earlier than others. As a result, many users complained that it took a very long time to get trained, and sometimes no training was provided at all. They also complained that

when they did finally get trained, their trainers were not professional, but rather other users who were involved in a particular area of SAP.

As a result, the BPnGIS team who was responsible for training was seen as quite irresponsible and unresponsive with regards to the training needs of the users. From the point of view of the BPnGIS team however, it was recognised that there would always be a trade-off of time, cost and quality, and that users underestimated how long it would take to prepare the training material. In addition, the training that was provided to employees in the company was accompanied with the handout of notes to cover the training session and other uses of the system. However, as it was mentioned by the BPnGIS team, the trainees never bothered to open their notes again after the training sessions.

There was also a SAP training server in Alstom, where users could go inside, run a transaction and see what the result would be, and learn that way. However, not many people used this functionality, as they did not deem it to be a supplement for formal training.

The next section describes the process of the creation of a new business in Alstom from the SAP implementation, and the problems that were faced.

5.5.4. Creation of new business unit

The implementation of SAP was also the impetus for creating a new business unit within Alstom, named PartsLink, whose aim was to stock and supply the depots in the UK (and especially the West Coast area) with spare parts for trains. This was important, as Alstom did not have a proper parts business to deal with spare parts for trains, and therefore it also did not have the systems to manage the spare parts.

As a result, the business processes were written around the system, in order to make the system work. The system was conceived and implemented by Andersen Consulting, who looked at what the business strategy was, and the processes that Alstom required. They then tailored SAP to suit the business needs of the company at the time SAP was implemented, in terms of for example the order processes, purchasing, inventory, warehouse, and logistics.

As a parts business did not exist before, people within Alstom did not know in detail how the business should be supported by the ERP system. Andersen Consulting therefore implemented their own ideas to a large degree, resulting in a system that was according to the views of many interviewees very inadequate. When it went live in April 2001, it seemed to work OK for about 3 months. However, it was then realised that some of the processes were very poor, especially

the financial ones. After about 3 to 6 months the company realised that they were making a big loss that they did not expect to make.

Andersen Consulting was thought to be responsible for this, having implemented the system. According to the Information Systems director (whose role subsequently changed to Logistics director) for the UK at the time the Parts Business was going live with the SAP system:

Andersen Consulting thought they knew how to implement a spare parts management system in SAP, we did not have the expertise here in-house, which meant that they [Andersen] were always able to convince the people they were dealing with what the right answers were. And it was a very poor implementation. (Logistics Director)

As a result of the poor implementation, there were still many problems around at the time of the interviews. As it was characteristically mentioned:

We've got a very complicated repair and quote process, and that process takes ages. It's an awful process; we haven't had time to sort it out. It's been in position for some years and people do it, they'll just say, well, if you want me to take 40 minutes to do this stupid thing, I'll do it! (Logistics Director)

However, there was actually no resistance in using the system at PartsLink, as the business was built around the system. This meant that if users resisted the system, they would be resisting being in the business. As a result, there was acceptance of the system, because there was not another way of carrying out the processes, and there was not an old system for which users could say that it was better.

With regards to the interface between SAP at PartsLink and the maintenance depots of Alstom (which also used SAP, but running different processes), a link was required. This link was not left to Andersen to develop, due to the poor experience that Alstom had with them, but it was decided to be developed internally by the BPnGIS team, who had a better understanding of the requirements. The link was called Genesis, and sat on top of SAP.

Before Genesis, if a maintenance depot wanted to obtain a part from PartsLink, it would have to place a purchase order with PartsLink, PartsLink would then have to create a sales order, and they would then ship the item. With the implementation of Genesis the two businesses became more integrated, which meant that parts could move on transfer orders. The depots could then use the Materials Requirements Planning (MRP) functionality of SAP, creating a transfer order from PartsLink down to the depot.

The next section looks into the implication of implementing the SAP system in Alstom, in terms of the perceived power differentials that were created, resistance to the system, as well as the perception of the users with regards to the system.

5.6. *Implications of Implementation*

5.6.1. Power differentials

As the concept of agency is central to this research, and agency is inextricably linked to power (Giddens, 1984), it is useful to examine some aspects of the power differentials that the introduction of the ERP system brought in Alstom.

As has been mentioned, during the implementation of SAP some employees of Alstom were released in order to participate in the implementation and contribute their business experience towards the development of the system. Many of those people did not have any proper training at all in SAP, but got to know it from working together with the Andersen consultants. Although those Alstom employees were released back to the business when the implementation of SAP finished, their experience of the system gained during its implementation made them become perceived as SAP experts by other users of the system:

And whilst the consultants were in Preston for 3 months helping other people load their data, I sat with the consultants, learning the system, saying, right, if I do this, how does that happen, how do I do this, and things like that. And just general questions, saying, right, there's more information to get. One thing led to another, and I became one of the, sort of, SAP experts within the business. (Business Improvement Coordinator)

As a result of gaining SAP technical knowledge, the perceived SAP experts became the first point of contact when users had problems with the system, as opposed to logging their problems with the BPnGIS team, and the BPnGIS team then trying to identify what the solution would be. The help of the perceived SAP experts was asked as they could go to the users' desk quite quickly to see what the problem was, and explain to them what they were doing wrong. However, the business rules indicated that in case of problems users should be contacting the BPnGIS team in the first place. By bypassing those rules and seeking the help of the perceived SAP experts instead, the power of the latter was increased in the company, as they could influence the way that the ERP system was used by other users. This meant that the perceived SAP experts could direct the agency of other users in terms of the way they were using the system. If the directions given to the users were right, then the intended control from using the system would be re-enacted, if the directions given to them were flawed, then it would be possible that drift would be propagated, by the end users using the system incorrectly.

It was also recognised that SAP administrators such as members of the BPnGIS team in Birmingham and the ITC team in Paris had more power than normal users in the system, in terms of being able to carry out administrative tasks in the system

which could influence other users (e.g. setting their access profiles). The normal day-to-day work of normal users was then seen mostly as following a series of mechanical steps, without involving any real decision-making, and therefore power.

The next section describes resistance encountered in Alstom as a result of the implementation of SAP.

5.6.2. Resistance

Although in the PartsLink business at Preston there was virtually no resistance to the system (as the business was built around the system), this was not the case in the other depots of Alstom. When the SAP system was installed, there was resistance to the system at various levels. Part of middle managers and users did not use the system fully, implying some resistance to it. In order to overcome this, initial training regarding the system was carried out, in order for the employees to understand what the system could offer. However, there was still resistance from middle managers to fully use SAP as a management tool. SAP was seen by many managers in Alstom as a financial overhead, and consequently there was not a lot of enthusiasm in supporting it.

This also had an impact on the users of the system. Resistance was evident there, also because users were used to the old systems installed in Alstom, some of which were still operational. In that sense, there was resistance of SAP, also fuelled by the fact that many of the users were considered as technophobes, and were not used to computing systems. The main complaints about the system were then that the system was difficult to use, was not user friendly, and users did not understand what all the fields and text in SAP were used for. To this lack of knowledge and apprehension of the system also contributed the general lack of proper training, as has been mentioned before. However, this type of resistance was considered normal, and seen to be overcome once the users felt more confident with the system:

That's just the normal resistance to a new system, because a lot of the Alstom people had other systems, which they knew and they were confident, and they knew what they could get out of them. And so it's just this transition to another system that they've got to learn and understand. But I'm sure once they can understand it, once they can use it, they'll be quite happy with it.
(Reliability Group Leader)

Resistance also arose because of the different processes in the system, and the interconnections between various departments of Alstom. In this case it was deemed necessary to make explicit what each department was responsible for,

otherwise people could always claim that some piece of work was not their responsibility:

I think when you implement an ERP system, it obviously cuts across departments. And then it's getting somebody else understand, you might have this extra bit of work to do, but it logically sits now in your department. And that's where if you don't get the business processes correct, you can get resistance on one area to the other. So unless you've got a bit of a process to tell you what each department is responsible for, I think you will always have trouble. (SAP Facilitator 1)

Resistance could also occur because of cultural reasons. For example, the implementation of SAP gave Alstom the opportunity to record and control time, and how long it actually took to do a job on a train. Nevertheless, the employees at the Manchester depot refused to do this when SAP was initially implemented at their site. On closer examination however, it was revealed that they would refuse to do this anyway, whether there was the SAP system or not. The intention of not recording time was a strong cultural aspect, but it was also local to the specific area. This kind of resistance was not mentioned to arise in other sites of Alstom. This refusal to record working times at the Manchester depot was in fact mentioned to be tied to contracts of employment and the influence of trade unions.

The next section discusses the view of the employees of Alstom with regards to SAP.

5.6.3. View of ERP

After the SAP system was implemented in Alstom, its role was viewed as more of a facilitative one, as opposed to a strategic one. However, in the particular case of the SAP system as it was installed at the Preston PartsLink business, the role of SAP was mentioned to be more strategic, as this was a new business unit built around the system.

SAP was viewed by most users as very difficult to use, and user unfriendly. This was seen to lead to problems with the end users, as they could not use it properly. Many users also expressed the opinion that there was a lot of duplication in SAP, with a lot of functions to capture the same information, and having to go to multiple screens to find one single piece of information. The layout and terminology in SAP was also mentioned by most users that were interviewed as not self-explanatory and clear. For example, many labels were difficult to distinguish what they were referring to:

You see on the screen here, it says “func location”, when you mean the train. So why does it not say “train number”? Then we have “equipment”, which talks about a vehicle, or one of the cars of the train. So why does it not say “vehicle”? (Abnormal Work Manager)

The perceived large number of fields in SAP also made it difficult to use the system, as users were confused about which ones were important and were supposed to be used, and which ones not. Removing some of the fields in the system was mentioned to be a much quicker and efficient way of working in the system. However, it was recognised that this would have an impact on other departments who were using those fields, and therefore this approach was not followed.

Before discussing the actual use of the system in more detail, the next section summarizes the contextual factors impacting ERP use at Alstom, classified in terms of existing organizational control and drift.

5.7. Contextual Factors Impacting ERP Use: Control and Drift

Alstom wanted to install SAP in order to have better control of its operations worldwide. However, at the time of the interviews Alstom was still quite far from achieving this aim. SAP was still being rolled out to many countries, where old legacy systems were installed, or even older versions of SAP such as R/2. Alstom wanted to keep the control of the system central, therefore ITC in Paris was charged with this role, and directly below them was the BPnGIS team, the headquarters of which were located in Birmingham. However, the relationship between the two was at many times seen as problematic, which in the end had an impact on the services provided to end users with regards to training and customization of SAP. Therefore, although training and a global IT department to oversee SAP were recognized as important in controlling the use of the system, in the end lack of training and perceived inefficiencies in the way ITC and BPnGIS operated caused drift from the company's intention of better controlling its operations through the ERP system.

In addition, drift was also perceived to occur from the poor implementation of SAP by the consulting company, as was indicated in the case of the parts business (PartsLink) at Preston. Andersen Consulting was blamed for not understanding the Parts business where SAP was installed, therefore providing them with a poor implementation that did not really serve the needs of the company. However, once the system was installed, it was difficult to resist it, as the new Parts business at Preston was new and built around the system; therefore resisting the system would mean that users were resisting the business unit they were working for. Resistance of SAP in other areas such as in the depots however, which included managerial and user resistance, also meant that drift from efficiently using the system was occurring.

Drift was also interpreted to occur from the (inadvertent) power differentials created by the implementation of SAP, where business users participating in the implementation gained advanced experience of SAP and were perceived as experts by other users. Drift was then interpreted to occur as the envisaged control over the use of the system by the ITC and BPnGIS teams was compromised, and the perceived SAP experts could themselves guide the use of the system by other users.

Having summarised the contextual factors impacting ERP use in terms of perceived organizational control and drift, the next section focuses on the actual use of the system, starting with the overview of the business operations of Alstom supported by the ERP system.

5.8. Use of ERP and Consequences

5.8.1. Business operations overview

Alstom had customer contracts with main train operators such as Virgin or ScotRail. Those contracts were for the regular maintenance of the customer trains, the fixing of faults on the trains as they happened, or a combination of both. In addition, Alstom could also carry out work on trains on an ad-hoc basis, outside normal contractual obligations, charging the customer accordingly.

The allocation of trains needing repair or maintenance to a particular depot of Alstom was carried out by a central unit located in Birmingham, named Central Fleet Control. If during the day there was an issue that appeared on a particular train and Central Fleet Control became aware of it (e.g. by the train driver phoning them), they would then put a notification of the fault in SAP. They would use the system after that to decide which depot the train would go to be repaired, based on factors such as distance to the depot, workload, priority of repairs, etc.

Some activities would be priority 1, which meant that work on the train needed to be completed before the train left the depot, otherwise the train would not be allowed to go back in service. Others would be priority 2, meaning that a defect should ideally be closed, but the train would be allowed to go back in service even if it was not attended to. Other activities could also be designated as priority 3, which would mean that they were less important, and any repairs could be delayed until the next scheduled exam of the train. Activities associated with priority 1 usually carried out penalties payable by Alstom to the customer (the train operator) if they were not completed in time, as stipulated in relevant Service Level Agreements between the parties.

When the trains arrived at the depot (usually at night, as this was the most appropriate time to carry out repairs as the trains were usually not in circulation), the exact list of the actual work to be done would have to be specified. This would be done by the operators at the workshops, describing the work to be carried out in services orders in SAP. These service orders could then be used to estimate how many labour hours would be needed, and what materials. It would also need to be determined whether the materials were available on site, or would have to be transferred from another site (usually from PartsLink at Preston).

The relevant service orders could then be used to produce Key Performance Indicators (KPIs), to see e.g. how many orders were cleared in a certain period, how many were left open, what was the average time to complete a piece of work on a train, etc. Those KPIs could then be used to show productivity in the department, but could also play a resource allocation role. If for example

Manchester had finished 100 service orders in one day but Wembley only 10, then this could be used as a basis to decide whether to allocate more work to Wembley if there was available manpower there to carry out more work.

The next section describes at a high level the workflow that was followed in the SAP system at Alstom.

5.8.2. Workflow

The figure below shows the main workflow inscribed in the SAP system. In many cases transactions in the system had a financial implication. For example, when a sales order was created by the sales department, this appeared in the billings-due list in the finance department. Similarly, when a penalty was to be paid to a customer (e.g. for late completion of work), the actual figures would have to come from the contracts from the selling department again, but the Finance department would have to authorise the payment before it was released.

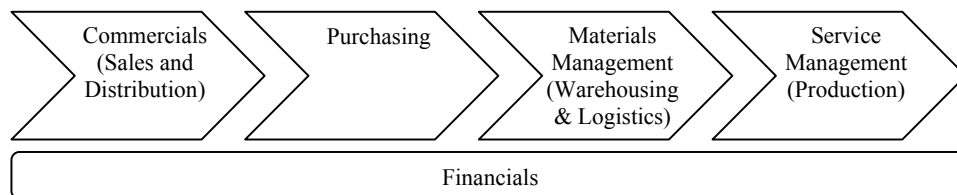


Figure 15: SAP Workflow in Alstom

The first part of the workflow (for the commercials and purchasing parts) involved the creation of a sales order for the supply of services to a customer (train operator) if a contract for the supply of those services did not already exist. This sales order could in turn result in a purchase order, if materials for the supply of services were needed (e.g. to repair faults on a train).

A potential side effect of this processing that was mentioned during the interviews was the case when the sales order was cancelled, but SAP did not automatically cancel the corresponding purchase order. This purchase order could then be used to buy the relevant materials, even though there was no demand for them as the corresponding sales order had been cancelled. The system in this case afforded the purchasing of items without a corresponding sales order, and users could intentionally or inadvertently use this in order to buy materials even though there was no demand for them.

The interdependencies that existed between the various steps in the workflow of the SAP system meant that an action in one part of the system had in fact

repercussions in following steps in the workflow. This meant that users had to think how their actions in the system would impact other users:

I think the biggest problem was that the people had to think, it's like the chess move story, people have to think a few steps ahead, what's actually going to happen, what they are actually doing ...There's the domino effect that's going on, there's nothing being done in isolation. One action will cause numerous interactions within the system. (Purchasing Manager)

A particular example of the interdependencies existing in SAP was between the Materials Management area and the Finance area. In the Materials Management area stock counts were carried out at several times during a year, to examine any discrepancies between the actual stock on the shelves, and the one declared within SAP. If any discrepancies were found between the actual physical stock on shelves and the one declared in SAP, then those would have to be put right by updating SAP accordingly. However, in order to do this, authorisation from finance in the system was required, as updating the stock in SAP during a stock count would have a financial implication as well, reflecting on the financial value of the stock.

However, sometimes the required authorisation from finance was not given to the Materials Management users, either because the required paperwork to prove the actual stock held on shelves was not readily available by the Materials Management users, or because the Finance users neglected to pay the necessary attention to it. As a result, the stock failed to be corrected in SAP.

In addition, SAP imposed a restriction that when two stock-counting periods elapsed, then the differences could not be posted in the system. This was in order to avoid the accumulation of past discrepancies which would result in a backlog of changes in the system to be carried out. However, this meant that at the end of the stock-counting period an incorrect picture of the state of the company with regards to stock reserves would exist. It also meant that stock that resided physically on the shelves but was not shown on the system could be used without reference to the system, therefore losing the control of it. And vice-versa, stock which was declared in the system but which was not physically on the shelves would result in loss of control with regards to the history and the location of the relevant items.

Those interdependencies between the actions of users in one department and those of users in another department are conceptualised with the theoretical framework of embedding/disembedding in section 5.9.4. Disembedded actions (or inactions) refer to users in one department using the system to carry out a transaction (such as finance giving authorisation for the stock count). This action then gets disembedded from the finance area to other departments or users concerned (in this case the Materials Management area). This disembedded action then gets reembedded locally (in this case by the Materials Management users) in terms of being able to use it as input for their own work (in this case carrying out the stock

count). As has been discussed by the example above, the interplay between human (disembedded and reembedded) actions and the machine agency of the ERP system can result in either control or drift. The relevant conceptualisation is shown in section 5.9.5. The next section however, discusses the access control functionality of SAP as it was implemented in Alstom, and the issues encountered.

5.8.3. Access profiles

5.8.3.1 Setting of access profiles

Similarly to the other companies examined, as part of the ERP system access control profiles had to be specified, in which specific groups of people were only allowed access into specific areas of the system. The profile for specific users would then be set to indicate the data, screens and transactions a user could access. For example, an audit book controller would not be able to maintain the materials master; users from the Purchasing department would not be able to go to sales pricing, inventory or warehousing, because it was not part of the purchasing function. The access profiles also distinguished between display-only and full (or no) access to data. For example, users in the Finance department could see the purchase orders created by users in the Purchasing department, but could not amend them. This mechanism of access controls in essence reflected a segregation of duties and control of responsibilities in the system.

Management of the access profiles was carried out centrally by the ITC team in Paris, through the input received from local offices. In particular in the UK, each site manager had to authorise requests for those access profiles from the users on the site. Those requests would then be put through to the BPnGIS team, who would implement them if it was something direct, but who would always have to refer them to the ITC team if any substantial authorisation changes were required.

Although Paris would determine the level of authorisation that could be given to different categories of users, no company rules with regards to the setting of those access profiles actually existed. As a result, it was identified that those profiles were not very well developed, and that users had in many cases the incorrect level of access to the system that they needed. As a result, ITC in Paris were putting pressure on the BPnGIS team in order to increase security in the system.

Nonetheless, at the time of the interviews there were still many complaints from the users with regards to the setting of those profiles. Most of those complaints had to do with the limited access to screens and transactions in the system, when access was required, but was not given due to the incorrect setting of authorization levels. As one interviewee mentioned:

That's quite annoying for me, because I have the information that I need to put into SAP, I've got the information of how to do it, but I'm not given the access to it, because someone has made the decision that only one person in the company is allowed to do it. (Shift Planner)

The required access could also be solved with display-only profiles. However, users also complained that there were unnecessary restrictions with regards to those display-only profiles as well. For example, in the Commercials area of the system, users that dealt with proposals and contracts needed to have access to those in the system, but they did not:

I understand maybe finance, but such as contracts and proposals which we use on a regular basis, they are restricted viewing them, which I can understand restricting it in changing it, but not viewing, because obviously you need to view it, to understand what you're doing, but they restrict that, which I find quite annoying. (Production Planner)

Display-only profiles were also useful for external auditors that came to the company and needed to look at SAP for the data they required. Their actions however did not impact on the system, as they only needed to interrogate the system, using display-only profiles. Several profiles existed in the system for that purpose, and they were disabled once the auditors were gone and the profiles were not needed any more.

On the other hand, users also pointed out that although needed access was unnecessarily limited in many cases, there were also many other cases where users were allowed to carry out tasks in the system, which they did not necessarily need to. This increased access to the system was mainly due to the inattention that was paid to the correct setting of the access profiles. The result was that the intended controls in SAP were seen to be very lax in some cases, because people had authorizations to do many things outside their immediate area.

In some cases users "abused" their increased access, because it was easier for them to do a transaction in the system themselves that they should not be doing, rather than asking the person that should be carrying out that transaction. As one interviewee mentioned:

For example, if there is something to be posted in the material master, because they [users outside the Materials Management area] have got authorisation and they've got some knowledge of the material master, they think, right, OK, I'll do it myself, rather than going to somebody who's got better knowledge, and say, right, OK, can you add this so I can carry on with my processing. (Business Improvement Coordinator)

In most of the cases however, the reason given by users for “abusing” their increased access was that Alstom was in a very fast business in terms of selling parts and maintaining trains, and if the customer wanted something urgently, then they would have to go into SAP and use (“abuse”) their increased access in order to provide this, instead of asking their colleagues to do this for them.

The next section discusses access controls in the Materials Management area in particular, as a large number of issues was identified there.

5.8.3.2 Access controls in Materials Management area

The way that access profiles were set up by ITC and used by users locally also depended on the affordances of the system. For example, in the Materials Management area it was not possible to separate between display-only and full access to the materials master, which contained the definitions of all materials used in the company.

The users in the workshops that put, picked up and relocated those materials into particular bin locations needed occasional access to the materials master in order to get information about those materials. Although display-only access would be sufficient in this case, SAP did not allow display-only access to the materials master, but only none or full access to it, the latter including updating as well. This was because it was deemed necessary to always be able to change material definitions in the materials master, if the user was to have access to view those materials.

In that sense the workshop users could change (intentionally or inadvertently) the materials master, although they were not supposed to. However, according to a materials manager, what was stopping them from doing it was that:

1. they probably don't know how to do it, 2. they've got brains. If somebody wants to go in and start messing things around, then they could do that. You can't live with access to a particular part of the materials master; you either got it, or you haven't. (Materials Controller 2)

The Materials Management area also had several other deficiencies with respect to the setting of the access profiles. Those related to giving users access to carry out transactions not only in the site where they were located, but in other remote sites as well. It was mentioned to have happened many times that a user e.g. in Birmingham went into SAP and booked an item out for another site; there was not any control in the system to stop him/her doing that, and this was a perceived deficiency of system controls.

However, this was not a technological affordance issue as the previous example with the materials master, as the SAP system in this case did enable the setting for access profiles to disallow users carrying out transactions in other sites. This shortcoming had more to do with a human agency issue, as the system was not correctly configured by the central headquarters in Paris in order to limit user access to their own site. However, it was also recognised that allowing more open access to the system had some side benefits alongside the negative consequences of it. This was the case for example, when a user was off sick, and there was only somebody in another site with the knowledge to carry out the corresponding transactions.

Still in the Materials Management area, the next section describes the way the intended controls in the system were bypassed by some users.

5.8.3.3 Bypassing of system controls

Access controls in the system were essentially implemented with the use of usernames and passwords that were allocated to each user, and which basically defined the user's rights of access to different screens, data and processes in the system. The use of usernames and passwords also meant that user actions were recorded in the system, so it could be seen for example that a particular individual entered particular data in the system on a particular date and time.

Although SAP supported the creation and maintenance of different user accounts in the system, and this was effectively used as a control mechanism in Alstom, it could still be bypassed by users. For example in the Materials Management area in Manchester, there were about 10 SAP users working in the workshop there, helping with the management and coordination of materials arriving at and leaving the site, allocating those materials to specific trains to be repaired, etc. From those 10 users there were 4 or 5 present at any one time, as the department operated in shifts throughout day and night. What was happening in this case was that there was only one terminal available where SAP was installed. Although each of those users had a unique username and password allocated to them, the first person that came to the machine logged in, and did not log out until he finished his/her shift. In the meantime, if other users came, they would use that person's log-in; they would not log that person out and log themselves in the system in order to use SAP.

When asked why the different log-ins were not respected, the response by the relevant users was that it would not be viable to do so, due to delays in logging in and out all the time for different users, as they were quite busy with other things in the workshop as well:

Everybody has their own login. Like, I'm logged in now. But if say there were 4 or 5 of us on duty today, somebody wouldn't come to it and log on; we'd use

whatever was in, just for speed. I suppose really, if I walk away from it, I should log off, and the next person who comes would log in. But it just takes time to keep logging off and logging in when you're busy. (Materials Planner)

Using one log-in for everybody in the workshop essentially meant that the intended controls in the system were bypassed by the users. If a generic logon approach was followed, then it would be difficult to tell who was or was not using the system. This would impact training as well, because one could not see how the individuals were performing in the system, and how the orders for materials were being processed, in order to see if there were any training needs.

Having a generic logon also meant that it would be impossible if the need arose to identify in the system who actually carried out a transaction. If a mistake was made in the system and it was attributed to a user who was logged in and his/her action was tagged in the system, the user could say that he/she did not do it and that other people were using his/her login. It was mentioned, however, that generally the superiors of the workshop users were not so much interested to see exactly who did a piece of work in the system, but rather how much had been done by everybody collectively, as opposed to work done by an individual.

Some users in the workshop at Manchester also had more access to screens and data in the system than others. This meant that when other users in the workshop were using another person's account, they could also have this increased access and potentially abuse it. However, it was mentioned again that they would probably not know what to do with this increased access, and would not therefore abuse it. It was also mentioned that trust played an important role in letting other people use one's account:

Everybody is more or less very trustworthy. Nobody would abuse it, I don't think. If somebody walks away from it [SAP] and leaves it logged in, they can more or less rely on people not to abuse that password. (Materials Planner)

However, most users apart from the ones in the Materials Management area that worked on the workshop, rarely used other persons' accounts in the system. This was also based on the fact that each one of them had their own computer on which to work, in contrast with the users in the workshop area of Materials Management at Manchester, where there was a shortage of machines on which to work.

Part of the access profiles were also authorisation levels specifying limits on financial amounts that users could handle in the system. Issues with the setting of authorisation levels at Alstom are described in the next section.

5.8.3.4 Authorisation levels

Generally users higher in the hierarchy in Alstom were allowed to handle larger financial amounts in the system than users lower in the hierarchy. This was reflected in the appropriate setting of authorisation levels (as part of their access profiles) for individual users in the system.

However, in some cases users did not have any set limits regarding handling of financial data in the system. For example, the Assistant Finance Manager at the Wembley depot could sign off any amount of billings to customers, without reference to her supervisor. This was because she was primarily aware of what was going on with regards to billing, so if there was a big billing invoice to go out, she would usually be aware offline that that work needed to be billed for. In contrast to the other users, SAP in the case of that person was not configured to indicate that if a billing was above a certain amount she would need to get authorisation from her superior.

However, on closer examination this did not reveal a lack of control by allowing her to bill for any amount of invoices. This was because most of what she needed to bill for, had already been agreed, and it was not something that she could just decide herself. The amount of billing had in fact already been agreed and entered into the system by the Sales department, who were subject to the normal authorisation levels. In that sense there was no danger of over or undercharging the customer, except if a mistake was made by the Sales department in the system. However, this was minimised by the Assistant Finance Manager comparing the entries by the Sales department in SAP with a hard copy that detailed the agreement between the company and the customer for the billing to be carried out.

Nevertheless in other cases, although the purpose of the setting of authorisation levels was to control the amount of money each individual was allowed to handle in the system, those controls could still be bypassed indirectly. For example, in the purchasing area users at a lower level (not managers) could place an order in the system up to the value of £1,000. Their usual weekly placing of orders was between £2,000 to £3,000. However, their daily limit of £1,000 for placing orders meant that in a week they could spend up to £7,000 if they wanted to, buying extra items the company did not need. Trust and managerial supervision played a crucial role in this case in making sure that those users did not overspend and used their buying limits sensibly.

The next section examines the visibility at various levels offered by the system. This visibility is linked to the concepts of embedding/disembedding that are analyzed in section 5.9.4.

5.8.4. Visibility

The integrative nature of SAP meant that actions of users in one department were seen by users in another department. For example, users in the Sales department could see in SAP what invoices were created in the Finance department. Respectively, when the Sales department created sales orders to charge a customer, this could be seen by the Finance department in order for the necessary invoices to be created.

As has been mentioned however, due to poor training and lack of knowledge of the system capabilities, many users were not aware of this visibility, and preferred to use more traditional methods such as phone in order to see if users in another department had completed their part in the system. For example in the Sales department, users had to ask the assistant finance manager at Wembley, verbally or by e-mail to create an invoice for a sales order they raised in the system, and then that person would e-mail them back saying that the invoice was created. This proved to be quite tedious, however, as it was not realised by users in the Sales department that this information could be more easily obtained from the system directly. The assistant finance manager then had to explain many times to them how to check the invoices in SAP, and make sure that they had been raised correctly by the Finance department.

Visibility in SAP was at various levels, according to the access controls in the system. As such, administrators of the system and other users who had more access to the system could see more of other users' data. For example, there were SAP facilitators in Alstom, whose job was to improve the use of SAP across the company. Those people were running certain reports that examined e.g. which required fields in service orders were being filled in by users and which were not, and by whom. In essence the SAP facilitators were looking at individual users, e.g. with regards to the time it took them to complete work defined in a service order.

However, although this kind of monitoring did exist, the view of the affected (observed) users was that no action was taken based on it, and no feedback was given to them. It was mentioned to be helpful to have such feedback, even if negative, in order to be able to improve individual work patterns. For example, if users were told that six hours to complete a certain job defined in a service order was too long, then they could try and improve on that.

On the other hand, the visibility of user actions that the SAP system afforded made some users nervous about what this could be used for. Visibility of user actions in the system in this case arose from the use of usernames and passwords to log into the system, and the tagging of user actions in the system with the username of the user that carried out a transaction and the date and time when the transaction was carried out. Some of the users felt nervous about this functionality, for example:

The thing with SAP though, it's the traceability. If we were trying to bypass the system, it's all traceable. You can look into who did that, what changes

you've made, they will come and hit you if you do try and bypass anything, because that's one thing with SAP, it doesn't lie, does it? It's got to put your name against everything, every time. (Inventory Planner 1)

I think it's that people can use it [SAP] to their own advantage. Sometimes there's too much information there, if you make a mistake or whatever, it can be used to the wrong advantage, which I am not too happy about... It's just up to the person, whoever decides they want to monitor, if they want to monitor someone, see what they're doing. So I am not happy with that idea. (Shift Planning Coordinator)

This apprehension with regards to monitoring of user actions in the system led some users to believe that anyone with the right authorisation could go and monitor what other users were doing in the system, and this could be used to highlight areas of inefficiencies with respect to the work carried out by them. This was seen quite negatively by those users, who considered SAP to be the means of giving people the opportunity to spy on other people's work, and then used for blaming them if something went wrong.

This apprehension of the system was also confirmed in the case of recording hours for a particular job done on a train. Although this required the inputting of individual hours for each user that worked on a train, the company was only interested in the total amount of time it took to do a job, rather than how much each individual spent in doing that job. However, users seemed hesitant to follow the recommended procedure of inputting hours worked in SAP, as they could not see the business benefit of it, and were worried about how their data would be used:

You have to record the individual's clock number. And that in itself is problematic, because you are identifying a particular individual, and they may think, oh well, you know, that's a bit too Big Brother, you're watching my every movement. But at the end of the day, we're not, as a business interested that it takes one man 20 minutes, but it takes another man 30 minutes to do a job. So, as a business we need to know that it took X man-hours for a particular job altogether. (SAP Facilitator 2)

As such, the fears of some users with regards to the monitoring capabilities of the SAP system showed a rather incomplete understanding of the way the system was used and its purpose in Alstom. This could be linked back to the lack of training that was mentioned before.

The next section looks at various checks carried out by the system that could impact its use.

5.8.5. System checks

SAP in Alstom was configured to carry out various checks that would ensure the quality and integrity of data in the system. For example, users were constrained from inputting an invoice twice. This could occur for example when users tried to create an invoice as a copy of the original one. In this case the system would check whether an invoice for the particular work and customer already existed, and come up with a warning about this. This would stop the user from entering a duplicate invoice, and was seen as a good control mechanism in SAP, in terms of minimizing duplication of data.

Another example of checks carried out by the system was if VAT on invoices was entered (manually) incorrectly, which would result in an incorrect total balance in the end. This could happen more at month ends, when users at finance would be busy trying to input everything in the system. In this case mistakes would be more possible than other periods, and so the relative financial journals would not balance in SAP. The checking of the balance across various ledgers was done automatically by the clicking of a button, and if there were any mistakes SAP would come up with a warning saying that the changes could not be posted in the system because the relative journals would not balance. Other smaller-scale examples of checks carried out by the system also included the format of the fields entered (e.g. for numbers, dates, etc), the range of the values the field could accept, etc.

Although the system provided those checks to ensure a level of quality of the data that was input into the system, in other cases the system was not capable of carrying out some checks that users deemed necessary. For example, when an item needed to be returned as broken to the supplier, it needed to be recorded into the system as such. However, there were no checks that the item was not accidentally booked into the good stock, although it was declared as broken in the system. The users in the workshops in this case deemed it necessary to have a warning message coming up that would inform them that they were trying to book broken parts into good stock. However, the system as it was did not carry out those checks, and would let the users carry on.

The next section describes systems external to SAP that were used in Alstom, and the impact of such systems on the organization.

5.8.6. Use of other systems

5.8.6.1 Excel

Similarly to the other companies examined, the standard reporting functionality of the ERP system (SAP in this case) was mentioned to be quite poor. Although sometimes some of the reports taken directly out of SAP would give all the information that was needed, the layout would generally be not right for showing those reports to management. This would mean that the company would need to employ external expertise, in order to develop more reports in the system, which could present the information needed in the required format and layout.

Existing reports in SAP could include for example the number of open and closed service orders in a given period, the number of purchase invoices processed per site, number of materials issued, received or transferred in a certain period, etc. However, as the reporting functionality of SAP was deemed to be quite poor, data were generally taken out of SAP and imported into Microsoft Excel for manipulation. Excel was considered more advanced in this case, in terms of being able to summarize and carry out calculations on the data, produce graphs, manage the layout, etc.

SAP in fact allowed the output of required data in a format ready to be imported into Excel. SAP had a reports tree which users could navigate in order to select the reports that they wanted to see from the system. Once they navigated to the required report, they could then specify parameters such as the dates or range of data, etc. SAP would then retrieve the required data in Excel format, which could be saved ready to be used in an Excel spreadsheet.

However, the use of Excel was not always a panacea for the production of reports. Users had to know Excel quite well, in order to be able to manipulate the data coming out of SAP. In the Materials Management area for example, the output from more than one areas of SAP had to be extracted at a time, and each of those outputs had to be entered into an Excel spreadsheet and then combined using specialist functions such as vlookup. This was seen to be too complicated and time-consuming to do, distracting the users from the main job that they should be doing, rather than having to learn complex functions in Excel to manipulate the data that were taken out of SAP.

In addition to data produced by SAP and entered into Excel for the compilation of reports, Excel was also used for the downloading of data from SAP and the communication of this data to other users. For example, a list of trains to be cleaned overnight was produced from SAP, downloaded into an Excel spreadsheet, and sent by e-mail to the cleaning team who would do the cleaning work on the trains, and who did not have access to SAP.

Excel was also used as a means of communicating with customers. For example, there was a lot of interaction with Virgin Trains, and this was done by e-mailing back and forth Excel spreadsheets, with details of work carried out on their trains. SAP was only used to initially get the data out in the first instance, and then any

changes or updates were made outside the system, directly on the Excel spreadsheet. Those changes could involve for example any disagreements that the customer had regarding the work carried out, the pricing of it, etc.

By working outside of SAP and inside Excel in all of the above cases however, there was a possibility of changing the data to give a false picture of the company. This was because the access controls that were enabled by SAP were essentially lost, as no access controls applied to the Excel file:

You have that functionality, it's very good, you can export it [data from SAP]. The problem is, that you can then manipulate the data [in Excel] into any way you want, you know, anyhow you want. And for me, that's potential loss of control, because, OK, if you imagine, 2 groups of people are producing the same data in theory, manipulating it slightly differently, and potentially you turn up with 2 individuals at the same meeting, with 2 different sets of data. (SAP Facilitator 2)

In addition, since Excel did not implement a workflow like the one imposed by SAP, it was much more difficult for other users to spot any mistakes (intentional or unintentional) in Excel that could have occurred.

In addition to Excel for reporting requirements in particular, another more specialised reporting software was also used at Alstom (Crystal Reports), which is described next.

5.8.6.2 Crystal reports

In comparison to access controls in Excel which were virtually non-existent, the controls in Crystal Reports as an alternative reporting application in Alstom, were a bit tighter. As very few people in Alstom had access to this reporting software, this made it more secure than Excel, in terms of limiting who could use the application. In addition, Crystal Reports was mentioned to produce more professional-looking reports than Excel, in a What-You-See-Is-What-You-Get manner.

It was also generally not allowed by the Crystal Reports software to make changes to the base data from which the reports derived (in contrast to Excel); only administrators of the Crystal Reports software were allowed to do this. This then enabled to produce reports based on the same data set that came out of SAP, in contrast to Excel, where data could be manipulated if needed. In this sense the output format of the data could be changed, but not the source data.

Apart from the use of SAP for the maintenance and repairing of trains, the next section describes an alternative system that was also used in Alstom.

5.8.6.3 Ravers

Another instance of the use of other systems apart from SAP in Alstom was a rail industry standard system named “Ravers”. This system allowed the recording of train faults and work done to fix them. Although the functionality of Ravers was seen to be much more simplistic in comparison to SAP, some users favoured this system compared to the perceived user-unfriendly SAP. Although the long-term plan was to switch Ravers off and only use SAP, this was deemed as not very straightforward to do, as Ravers was used by many of Alstom’s customers such as Virgin Trains or ScotRail, who stipulated that data regarding the maintenance of their trains should be entered into Ravers, so that they could then import them into their own Ravers system.

ScotRail for example did not have access to SAP, but had access to Ravers. The requirements of ScotRail involved access to a full vehicle history of what work had been done by Alstom on their trains, and this information was input by Alstom in Ravers. However, Alstom also needed this type of information for their own use to be held within SAP. Therefore, once train defects were created in Ravers, the defect numbers from Ravers and all the relevant information were input into SAP. By doing so, Alstom could also demonstrate to ScotRail that the two systems (SAP and Ravers) were matched together. This came out of an audit by ScotRail, which indicated that not everything that Alstom was doing on the trains was recorded in Ravers (although most of it was recorded in SAP), and consequently Alstom was asked to put some procedures in place to enable the two systems to hold the same information.

This meant that duplicate data (in different formats) had to be entered into SAP and Ravers. This was a problem for Alstom, as on a night shift a user could create and close up to about 60 service orders in SAP. If those then had to be duplicated into Ravers, it would be very tedious to just (manually) input the same data into two different systems in different formats. As a result, many times data were inserted into one system (SAP or Ravers) but were forgotten to be inserted into the other system. There were some discussions at some point to commission the writing of an automatic interface that would exchange and synchronize data between SAP and Ravers, but this was assessed to be too expensive, and as a result the idea was abandoned.

In order to examine the existing inconsistencies in the double data entries (SAP and Ravers), the data residing in both systems had to be inspected, to see if there were any discrepancies. In order to do this, the corresponding data from Ravers and SAP were loaded into an Excel spreadsheet and examined manually. To avoid this situation as much as possible, users were essentially told to input everything into Ravers in the first instance, and then use copy-paste to input the relevant information into SAP. Although this was mentioned to be a simple process, in essence because of the different fields and layouts of the two systems, users spent a

lot of time on double data entry into the two systems, which in turn decreased their productivity.

Although Ravers as a rail industry standard had to be used by Alstom as well, its use meant loss of control for the company, because of the constraints in the functionality of the system. For example, Ravers did not record the user who carried out a transaction, or when the transaction was carried out. This meant that in case of queries, it would be impossible to determine which users input the relevant data into Ravers and when. In addition, Ravers had various other limitations compared to SAP, for example there was only one line of text allowed for the defect description, and only one line of text for the repair description, which was very frequently not enough. This meant that some critical data were not captured, for example whether a fault on a train was a repeat one, or what it was caused by. SAP was seen as much superior in this sense, in allowing the recording of important data with regards to faults and repairs carried out on trains.

The next section describes another system used by the rail industry, also used within Alstom in addition to SAP.

5.8.6.4 Tact

In addition to Ravers, another system which was used in Alstom in order to manage its interactions with other companies in the rail industry was called “Tact”. This system was used to hold data for the Bombardier company, which was active in similar areas as Alstom, for example in the provision of products and services in the rail industry. Tact allowed the managing of Bombardier stock that was held within Alstom’s premises.

Although Alstom was in competition with Bombardier, there were also some synergies, mainly for the provision of parts from Bombardier for the trains that Alstom was servicing, in particular the Voyager Fleet that was sold by Bombardier to Virgin trains. The parts were not owned by Alstom but by Bombardier, but they were kept in the Alstom warehouses in case they were needed for the repairs of trains. As such, the business relationship between Alstom and Bombardier demanded the installation of the Tact system that was used within Bombardier to be used by Alstom as well. This was also due to the fact that SAP did not allow for the handling of stock belonging to another company from the one using the system.

In similar lines to Ravers, Tact was also seen to be more simplistic compared to SAP, and also much older and slower. The Tact system did not interface with SAP at all, and was seen as very easy to use. This was also due to the fact that only two types of transactions were carried out in Tact, issuing stock and receiving stock, which required much less training compared to SAP. The Tact system that was used in Alstom was owned by Bombardier, and any Bombardier parts that were

issued would have to be entered into Tact. The Tact system in Alstom would then connect directly to a Bombardier depot, so that the latter could see the transactions carried out by Alstom employees in the system.

The next section presents yet another system that was also used in Alstom, a rail industry standard system called Trust.

5.8.6.5 Trust system

Trust was an old Network Rail legacy system that monitored every train on every track. The system was updated automatically in real time with regards to arrival and departure times of trains at each station, and those results were held centrally by each rail company (e.g. Virgin). Those results were then used in negotiations between the rail companies and Alstom, in order to examine the performance of the trains and increase their reliability in terms of failure rates. As the Trust system was updated automatically and did not require human input, it was seen to be impartial with regards to the data concerning train arrival and departure times at each station that it contained.

The next section discusses the way that a combination of some of the above presented systems was used in Alstom, in particular by the Reliability Group within the company.

5.8.6.6 Combined use of systems – Reliability group

For the purpose of monitoring the performance of trains with regards to delays, a reliability group was set up in Alstom, within the Production department. This group was in particular responsible for increasing the reliability of Pendolino trains for the Virgin Trains customer. This involved reducing the number of Service Affecting Failures (SAFs) on trains, which were defined as any failures that would delay the train by more than 3 minutes while in operation. This meant that the cause of such failures had to be examined while work was carried out on trains, and remedial action taken to reduce the number of those failures.

The metric that was used for determining the reliability of Pendolino trains was then the mean distance between service affecting failures. This was measured in miles, for example the target would be 32,000 miles or higher from one SAF to the next. In addition, another metric named Impact Minutes was also used to determine the impact of train delays. Whereas SAF was referring to a delay on just one train, Impact Minutes was referring to the total delay in minutes that a delay on a train caused to other services. For example, if a train failed on the fast line going from Manchester to Euston, which was a very busy line at peak times, this could delay a number of other trains behind the failed one. This would then mean that if for

example 10 other trains were delayed for 3 minutes each, this would be a total of 30 impact minutes altogether. Total daily impact minutes of 1,000 to 2,000 per day across the whole UK network were mentioned not to be uncommon.

Virgin trains paid a penalty to other companies for all the impact minutes it was responsible for, and Alstom paid penalties to Virgin trains for all the Service Affecting Failures that it was responsible for. As such, it was deemed very important to try and improve those metrics as much as possible. It was also a matter of meetings between representatives from Alstom and Virgin trains to discuss and decide which failures were the fault of Alstom (e.g. through poor workmanship on trains) and which were not. During those meetings the strategies for the improvement of Service Affecting Failures and Impact Minutes were also discussed.

In order to reach the targets set by Virgin trains, repeat failures were very important to monitor, as well as the parts of the train that resulted in the most failures. Most of such data could be obtained directly from SAP. This data could include for example the information that was entered by Central Fleet Control in Birmingham with regards to the notifications they received from the train manager concerning the failure on a train. It could also include what work was done on the train to investigate and remedy the causes of failure. This also comprised looking at the history of failures in order to understand whether a failure was a frequent one, or just a one-off occurrence. Data from SAP could also help determine whether the failure was due to external factors, or due to work carried out by Alstom previously on the trains, for example by using parts that were substandard or problematic.

However, SAP alone was not sufficient in order to get the full picture of the causes of failure of a train. In order to find all the information that would enable to determine the causes and nature of failures, one would have to also look at Ravers, Tact and/or Trust. For example, information regarding the failure could have been input into Ravers by users in the Production department, but forgotten to be entered into SAP as well. If parts from Bombardier were used on a train (e.g. for a Virgin Voyager train), then those parts would have to be examined in the Tact system. In addition, information regarding the time of the failure could be input in SAP by Central Fleet Control, but this was not considered accurate, as it depended on human input and was prone to inconsistencies. Therefore the Trust system also had to be used to determine the exact time of failures.

The difficulty with looking at all of those systems to determine causes and nature of failures was seen to be very time-consuming. Although many disparate systems were still being used in Alstom in addition to SAP, it was nevertheless recognised that this was a necessity, as it was not seen as possible to have only one system that would be able to provide all the information that was needed:

No one system can give us all the information, and I don't think it ever will. So, I can't ever see how you can bring all that into one system, and still be user-friendly. (Reliability Group Leader)

The issues mentioned so far regarding ERP use in Alstom (such as access controls, authorisation levels, workflow, visibility, system checks, use of other systems, etc) were also observed (albeit to a smaller extent) in the initial four companies (Multiyork, Chubb Fire, NTL, Reuters) examined in chapter 4. The next section describes in more detail some more focused issues of ERP use in Alstom, starting with the management of abnormal work.

5.8.7. Detailed examination of other issues on ERP use

5.8.7.1 Abnormal work management

Work carried out on trains which was outside Alstom's contractual obligations with a customer, was classified as abnormal work. Normal maintenance work on trains included exams, service cleans, and repairing all the incidents which arose because of the normal wear and tear on the vehicle. The exams were a large part of Alstom's work on the trains, and if those exams led to finding out that something was defective, through no fault of anybody other than from normal wear and tear, a service order would have to be generated in SAP and the corresponding work carried out on the train.

On the other hand, abnormal work was anything outside normal wear and tear, for example a passenger on the train vandalising a toilet, or causing it to flood, which was a typical example. An abnormal incident could also arise from the rail infrastructure or other external factors, for example a train hitting an obstacle on the tracks or a tree falling on the train and ripping off the paint. Those kinds of events fell outside Alstom's control, and they were not associated with the maintenance work. Consequently, Alstom could claim some recompense for relevant work carried out. Although the percentage of abnormal work compared to normal maintenance work was quite low (10-15%), money was still being lost if abnormal work was not charged for.

However, Alstom to a large degree had not been accounting for abnormal work carried out on trains. The company had not looked at SAP for ways to bill for work carried out outside contractual obligations. The configuration of SAP to accommodate this was not seen as difficult to do, the difficult part was seen to be deciding on the processes to account for abnormal work carried out in Alstom.

The fact that money was essentially being lost by not billing customers for abnormal work carried out on trains was in the end recognised by Alstom, which appointed an Abnormal Work Manager. His responsibilities included examining SAP to obtain information about abnormal work. He would then quantify that work and give it a monetary value, so that customers of Alstom could be charged as a consequence of doing that abnormal work.

In order to investigate abnormal work, a report was set up in SAP that allowed examining particular types of such work. A list of service orders was obtained in this report, which would list jobs done on a particular train. Abnormal work in these service orders would be normally coded with a different code than normal maintenance activities. However, some work which was coded as normal maintenance activities could be miscoded by the users that carried out the work on the train. Part of the responsibilities of the Abnormal Work Manager was then to go through these service orders, looking for work done which was abnormal but not coded as such, so that the coding could be changed, the costs could be verified, and re-claimed from the client.

The procedure for agreeing the details of the abnormal work with the customer (for example Virgin Trains) was managed centrally by the Sales team in Birmingham. This team would have a monthly face-to-face meeting with the customer, in order to present the instances of the work done on trains where Alstom thought they might have a case with regards to abnormal work. The information that was contained within SAP would be used in those meetings, in order to prove to the customer that a particular issue was an abnormal situation for Alstom. In that sense, good quality data had to be input by the SAP users into the system, to be able to decide whether an incident could be classified as abnormal work. There was a descriptive text field in SAP which could be used for that purpose, and in this field it could be specified that e.g. a toilet was defective because something had been forced in it, causing it to block. The Abnormal Work Manager's responsibilities then also included cleansing the data in SAP, in order to present it to the Sales team, who would use it for the face-to-face meetings with the client.

However, there were many instances where the required information to decide about abnormal work was missing or was incomplete in SAP. This mainly concerned the descriptive text field from which it could be deduced whether the relevant work was abnormal or not. In that sense the quality of the data that was input into SAP by users in the workshops where the trains were repaired was very important. If any information that would enable the identification of abnormal work was missing in SAP, this would be communicated to the head of Production, to instruct members of his team to investigate it further.

Missing information also included the labour hours worked on a case that could be considered as abnormal work. The process that was used in Alstom for recording labour hours was very long-winded and resource-intensive. This meant that in a lot

of instances the users at the Production department would not bother recording the labour hours against the relevant service orders. This would then have an impact in cases of abnormal work, as it would not be possible to determine exactly how much to charge the customer for according to hours worked. It was therefore necessary to make sure that the labour hours were recorded in SAP.

More detailed description on the management of working hours and their recording in service orders in SAP is discussed in the next section.

5.8.7.2 Recording hours in service orders

Before the introduction of SAP, the process of dealing with service orders and correctly allocating hours worked to them was very complicated, because of the large number of service orders and the fact that they were paper-based. Paperwork in this case only remained live and easy to retrieve for a very short period of time. After a week it would be archived, and it would then be difficult to retrieve it if required.

With the introduction of SAP in Alstom, the handling of service orders improved greatly, as the service orders were now held within SAP. However, there were still problems in terms of correctly allocating hours worked to those service orders. This was mainly due to the fact that the users at the workshops were asked to record their working hours in SAP according to normal work and abnormal work, which was described in the previous section. However, the users at the workshops often lacked the knowledge to determine which jobs were considered normal (within Alstom's contractual obligations) and which were abnormal (outside Alstom's contractual obligations). As such, users tended to record the time they had spent on a train in a descriptive text field of the service order instead of the actual allocated fields in SAP for the hours worked.

By doing so however, no analysis could be carried out such as total hours worked on a service order, as the field was just text with no functionality behind it. Nevertheless, although still a labour-intensive process, it was now easier with SAP than with the historical paper-based system to go back and allocate those hours correctly to the right fields.

Having identified that this problem of incorrectly recording hours in SAP existed, the company commissioned two members of the Service Management department to investigate methods of streamlining the process of entering hours worked in service orders in SAP, so that actual hours could be correctly recorded against every single service order. This information was important to the company in case they were going to make a claim with a client for abnormal work. It was also important in order to manage the business correctly, because there was obviously a

need to know how much time was spent doing work on service orders, so that labour efficiencies and utilisation of labour could also be looked at.

Part of the responsibilities of those two employees was then to find a simple solution to capture the hours for everything in the system. The proposed solution was to push the users at the workshops to record in SAP the hours of every job that they did independent of normal and abnormal work considerations. The Sales department would then identify which of the work done fell within the contractual obligations of the company, and which did not.

Although recording hours for each work done on service orders required a lot of business push, recording materials used for the same work was more straightforward. It was much easier in this case for the users at the workshops to see exactly what materials had been used to repair a train and enter them into SAP. SAP also forced users to allocate materials to a service order whenever those were purchased or booked out from stock, so it would not be possible to not allocate them to a particular service order.

The next section discusses another issue with service orders, concerning their correct definition and management.

5.8.7.3 Maintenance of service orders

Attached to service orders were task lists that detailed what exact work needed to be done on a train as part of the service it required. Those task lists were used to plan and allocate the human and material resources that were needed to carry out the work on the train. If the task list was defined incorrectly, then this would mean that the planning and allocation of the resources for the relevant work on the train would also be defined incorrectly. The service orders were opened (created) just before the physical work on the train started, and they were meant to be closed immediately after the physical work on the train finished. After the service order was closed in the system, then the work carried out on the train could be billed for to the customer, when this was applicable (e.g. in the case of abnormal work). The relevant human resources would also be shown as being available in the system, for planning purposes.

However, many times service orders were forgotten to be closed in the system by the workers that carried out the work on the trains, although the physical work was completed. As they handled a large amount of service orders every day, it was in fact very easy to forget to close down some of them. The problem with that was that resources would still be shown as allocated to those service orders, and hence future work would be planned inefficiently. Also, it would be a potential lost sale, because until the service order had been closed and the sales order generated, the company could not bill the customer for it (e.g. in the case of abnormal work).

The service order system in Alstom was an issue for the Production department, and it was viewed as a tool for managing the work to be done on trains. Therefore the personnel at the Production department were responsible for the integrity of the service order data, including whether a service order should be open or closed. In that sense, if a service order was left open, technically it would mean that it was work in progress. The users at the Production department would then have to be responsible for closing down service orders, because there was a safety implication as well; the service order could only be closed when it was absolutely certain that the work had been done and signed off, as a lot of the work that was done on the trains was safety-critical.

The next section goes into more detail with regards to the quality of the information that was input into SAP, and in particular in the case of service orders. Poor information quality would in essence result in drift from the goal of efficiently managing the data residing in SAP.

5.8.7.4 Information quality

In addition to the service orders being correctly closed, the quality of information that the Production department received to enable the service orders to be opened efficiently was also very crucial. This information was received via the Central Fleet Control of Alstom in Birmingham, who input a notification in SAP whenever they received phone calls from train managers about defects that needed to be fixed. Central Fleet Control would also allocate a depot that would carry out the necessary repairs on the train. The Production department at the relevant depot would then receive this notification in SAP, and use it in order to create the relevant service order to allocate labour and materials for the work to be done on the train.

However, the quality of information that arrived to a depot's Production department from Central Fleet Control was many times inadequate, either because the train managers did not have all the required information, or, less frequently, because operators at Central Fleet Control did not input all the information they had available into SAP. For example, if the notification put by Central Fleet Control into SAP included something vague like "2 toilets locked out of use" then it would be difficult for the planners at the Production department to allocate human and material resources beforehand to fix the problems. This would then mean that another person at the depot would have to go to the train and have a more detailed look when it arrived at the depot. This would mean loss of time in order to carry out the necessary inspections.

On the other hand, the information coming from Central Fleet Control could be more detailed, for example "1. First toilet is locked out of use because sink is

blocked, by somebody putting cigarettes in the sink. 2. Second toilet is blocked because caterpillar track is damaged at the door”. If information coming from Central Fleet Control was in that level of detail, then resources could be planned more efficiently before the train arrived at the depot.

The insufficient quality of information in SAP could also be seen in cases where detailed checks on trains were carried out, in order to diagnose potential faults. Those checks were done in steps, each step depending on the findings from the previous step. It was very common for users to just tick each step in SAP as “tested”, and then move on to the next step, without inputting any more information. However, SAP provided a descriptive field in each step that users could use to input more detailed information about the outcome of their checks. Users in most cases did not fill in those fields, as they could not see the importance of inputting the relevant information in SAP. However, this made it very difficult if problems arose and the history of checks needed to be examined, in order to see what was done during the checks. As users did not provide this information, it was then not possible to see exactly what faults were found during the tests, and what was done to correct them.

The quality of information that was input into the system was generally recognised as very important for the correct functioning of the system:

I think the big problem we've got with SAP at the moment is the quality of data being entered. I think there is a perception that nobody is using SAP, for once the information is entered, it's forgotten, it's never used again. And therefore a lot of the information that gets put in is completely rubbish. And that can only be changed by the people using it, there's nothing SAP could do to make that any better, that's entirely human. (Reliability Group Leader)

Any transaction you carry out on the system, you trust an individual to put the right data in. Because if you put the wrong data in, you are going to get the wrong data out. So you've got to trust, there's no way that the system can dictate what information has got to go in there, it's the trust that the individual is putting the right data in. (Materials Controller 1)

In addition to the issue of the quality of information that was input into SAP, the timing of inputting that information was also important. For example, due to the vast number of jobs done on trains and the associated number of service orders, work on a train could start before the relevant service order was created in SAP. If this mistake was realised later on the same day or the next day, this could be too late, as the train would be repaired by then, and left the depot. This would then mean that it would be difficult to identify without any records what work was done on a train. Even worst, if this mistake was not found at all and the service order was not created, then the train would have been repaired for free, without charging the customer for it.

For users that needed to input information into SAP, in order to increase their input in fields that were quite important (such as the recording of hours spent on a job), also realizing that some of those data were at times not easy to provide, some workarounds were done in the system to increase the chances of having this input. For example, certain fields that were not mandatory in SAP were made to look mandatory, by putting a tick next to them. This created the illusion that the user had to fill those fields in, although if they were left empty the system would not generate an error. Those workarounds could be seen as a trick to alleviate the fact that making all important fields in SAP mandatory was not going to work:

If it was for me, I would say, make all the fields mandatory, and you have to fill them all in. In the real world, you could never do that. There's time constraints for one, availability of information, two. So you would have the end user who wouldn't use the system. (SAP Facilitator 2)

Related to the quality of information that was input in SAP was also the use of free-text fields, described below.

5.8.7.5 Free-text fields

With regards to the recording of hours in a service order, as it was mentioned hours were many times recorded in free text fields as a memo, rather than on SAP-allocated fields for the recording of those hours. The use of free text fields in general was a norm in Alstom, as people did not understand what the rest of the fields in SAP denoted, and preferred to capture all the relevant and important information in those free text fields, instead of the ones allocated by SAP.

As in the case of the recording of hours, however, capturing important information in text-based fields meant that analysis could not be carried out, and important information was missing from the system. For example, text based fields were used by some users (especially new to the system) to record prices in a sales order. If prices in a sales order were not recorded in the SAP-allocated field for prices, then this meant that in the end no analysis on the total charged to a customer could be carried out. Therefore although the system afforded the capturing of essential information, this could be bypassed in Alstom by capturing important information in the wrong fields, which in the end would result in the wrong data being held in the system. The bypassing of the information capture by users was mainly a result of lack of proper training and the perceived user-unfriendliness of SAP.

Another negative consequence of the use of free texts to record important information in SAP was that standardisation was lost. This would be because SAP did not carry out any checks on the free text to make sure it was meaningful or according to pre-specified criteria. For example, in a service order, users might use

the free text field to write “rotating axle” or “locked axle” needing to be changed, but those two would refer to the same material. It would be impossible for SAP to recognize that those two free texts were basically the same, as the user could type anything in those fields, as opposed to selecting from a pre-defined list of materials:

You can't just program a computer to identify that. Some people call things differently, for example this high-axle box, some people would put "AHABD", and everybody knows it means high-axle box, but other people would write "High-axle box". So you can't really program a computer to identify that. (Production Planner)

Also related to the quality of information was the case when information was totally missing from SAP, for example regarding the setting up of contracts with a customer. This is described in the next section.

5.8.7.6 Contracts' setup

Another issue arising from the use of SAP and the quality of information that resided in it was when contracts with a customer of Alstom were not properly set up in the system, or not at all. The Sales department was responsible for inputting into SAP a new contract as soon as this became effective. However, contracts were usually set up in SAP at a much later stage, and many times after work on customer trains had been carried out. This meant that in the end money was lost, as the necessary information to enable charging the customer for work done on trains was missing from the system.

This was in fact more of a business issue rather than a SAP issue, as the relevant users in the Sales department knew how to set up contracts in SAP, but their superiors failed to release the relevant information to them, so that they could set up the contracts correctly in SAP. This was also because at some periods there was a high turnover of trains to be maintained, and it was easy to get things mixed up. It was also a training issue in some cases, as the people who should be setting up contracts in SAP did not have all the necessary knowledge to enable them to do so.

As the relevant contracts were not correctly set up in SAP, working hours could also not be allocated for work on a particular train. This in turn had an effect on the billing of the work done, as no billing could be carried out without the recording of the working hours done on a particular train and the customer to which this train belonged. For example, the sales orders could be created by the Finance department for work carried out on a train, but this would stop there and could not be sent to a customer, as the relevant contract was not correctly set up in SAP.

In addition, if the contract was not entered at all into SAP, this also meant that it would be impossible to calculate how much money was lost from billings, as the billing details would be specified in the contract. Although materials used on a train could be calculated and a value placed on them, this would be different for every customer according to discounts and other factors which affected their value. It was therefore imperative to have the contract correctly set up in SAP before potentially charging a customer for work done.

In order to avoid delaying work on the trains and releasing them back on operation as soon as possible however, all the necessary repairs were done on the trains and then released back into operation even if the contract was not set up in SAP. This meant that users in the Sales department would have to retrospectively examine the service orders for the work carried out on trains, determine offline which customer to charge and enter this information in SAP. However, this was a very inefficient way of carrying out this process, and could be much sped up if the customer contracts were set up correctly in the system in the first place.

The next section presents an instance where lackadaisical use of the system could lead to inefficiencies and potential loss of control over the company's data.

5.8.7.7 Moving average price

Within the system there was functionality to enable users to specify a “moving average price” for each type of materials specified in the system. This was necessary in order for the purchasing department to be able to monitor the variation in the prices of materials that the company bought from suppliers. The system constrained the user to input a value for the relevant field, otherwise the corresponding materials in the system could not be checked out, or transferred to another site.

The responsibility to enter the moving average price in the system resided with the users at the Materials Management area, who had to maintain this field. However, those users did not see the importance of maintaining this field and its impact on the purchasing department. As such, they neglected maintaining it, with consequent problems in the transfer of materials.

As a result of this, when materials needed to be transferred off site, the users that needed to do the transfer in SAP went into the system and put a fictitious price to make it work. This was usually 1 penny. Although they could phone the people that did the booking in of the materials and ask them to change this price, this was perceived as time-consuming and holding them back from booking out the materials, therefore they preferred doing it themselves in order to save time. If the wrong moving average price was not spotted and corrected however, then this

would mean that the wrong price would be used for the relevant materials, resulting in loss of control over the accuracy of the data in SAP.

With regards to the actual transfer of materials, the next section describes another instance of perceived inefficiencies in the use of SAP.

5.8.7.8 Transfer of materials

When transferring materials from one site to another, three different transactions had to be carried out in the system: picking the item, packing it, and posting it. For each of these transactions an entry was created in SAP. However, in reality there was not much difference in those activities from the point of view of the person physically carrying them out, as only one person carried out all three. This meant that time was wasted in the system, by having to input three different transactions, when a summary one would suffice.

It was mentioned that the current way of working in the system would be more suitable if there was a separate person or department that picked up materials, another one that did the packing, and a separate one that did the posting. However, as one person did all three, this was quite inefficient. The impact of the time wasted would be mostly felt when several items had to be transferred, and for each of those items 3 different transactions would have to be done in SAP, essentially tripling the time that the person needed to sit in front of the computer. This was therefore a negative characteristic of the affordances of the ERP system, which users of the system could not bypass.

The next section discusses an instance of bypassing intended controls in the system, exemplified with the use of a “source list”.

5.8.7.9 Source list

In SAP there existed a “source list”, which contained the suppliers from which the company could buy items required for the maintenance and repairing of trains. The source list existing in the system was created and maintained by the system administrators at BPnGIS, and a block was put in the system to disallow other users from amending it, so that only authorised suppliers identified in the source list could be used to buy materials from.

However, users identified a way to bypass this, by creating a new source list in the system, rather than using the one created by the BPnGIS team. The creation of new source lists was enabled by the administrators in SAP especially for the purpose of transferring materials between different sites. In this case users were given the authority to create a new source list, in order to specify for themselves the transfer

sites they wanted to transfer materials from/to. However, users found out that they could also use this in order to specify new source lists for buying materials from outside suppliers as well. SAP did not distinguish between internal and external suppliers; therefore users could abuse their extra authorisation for creating source lists. This meant that they could effectively include any supplier in their own source list, and buy from any of them, without reference to the approved suppliers in the BPnGIS-maintained source list.

The next section describes instances of bypassing system controls, simply by working outside of the system.

5.8.7.10 Working outside the system

The system could also be bypassed by working outside it. For example, when repairing a train and a service order was created for this purpose in SAP, this would have a number of materials attached to it that were needed to fix faults on the train. Those materials could be charged back to the customer, if the work to be done on a train fell outside the contractual obligations of Alstom (i.e. was classified as abnormal work). However, some of those materials could take a long time to arrive from the supplier after they were ordered. In the meantime, there was a control in the system that an invoice for those materials could not be created until those parts had been received from the supplier and entered into the system. When there was a critical mass of those materials and delays in receiving them were foreseen, then a manual invoice was created outside the system, and sent to the customer. This then meant that in essence the Finance department could not account for this invoice in SAP, as there was no record of it there. It also meant that a big clean up operation would ensue, going through the process of entering the materials in SAP when they arrived from the supplier, creating the invoice in SAP, but making sure that it was not sent to the customer again. Only then, when the system was brought up-to-date, could Finance then account for the invoice to the customer.

Having described the use of SAP in Alstom, the next section summarizes these findings in the form of an analysis on the dimensions of human and machine agencies, their interplay, and their impact on organizational control and drift. The embedding and disembedding of human actions in the system are also discussed.

5.9. Analysis and Discussion

5.9.1. Machine agency

Based on the presentation of ERP use in Alstom, Table 21 below summarizes identified instances of the machine agency of the SAP system, in terms of the actions that it allowed or constrained to its users (i.e. the technology affordance of SAP). The results of the machine agency of SAP (control and/or drift) are also shown in the table below, together with the important relevant codes (in brackets) from the coding structure in Figure 7, as well as comments explaining each identified instance of machine agency.

Table 21: Technology Affordance (Machine Agency) of ERP system at Alstom

Technology Affordance (Machine Agency)	Result (Control/Drift)	Comments
Setting of Access Profiles	Control (Access Profiles)	Similarly to the other companies examined, access controls ensured authorised access to data and processes in the system
Allowing different authorisation levels for the handling of financial data	Control (Access Profiles)	Authorisation levels (as part of access profiles) ensured that individuals could handle financial data up to a certain limit
Allowing display-only access to some screens	Control (Access Profiles)	Display-only access ensued that individuals could not update data they should not
Disallowing display-only access to Materials Master	Drift (Access Profiles)	The fact that the system did not allow display-only access to the Materials Master meant that either full or no access to it was allowed, resulting in drift from the ideal of giving users exactly the access they needed
Allowing different logins to the system	Control (Access Profiles, Visibility)	Allowing different logins to the system ensured that user actions were tagged with that login, allowing visibility of their operations in the system
Allowing registration of customer details for a contract	Control (ERP Properties)	This ensured that customer details for a particular customer could be stored and accessed when needed
Allowing capturing of non-contractual requirements (abnormal work)	Control (ERP Properties)	This ensured that work that was done on the trains and which fell outside contractual obligations could still be billed for
Allowing capturing of hours worked in a service order in relevant fields in SAP	Control (ERP Properties)	This ensured that hours worked on a particular job were accounted for
Allowing opening and closing Service Orders	Control (ERP Properties)	This ensured that work could be designated as started or finished in SAP
Not containing self-explanatory data labels for fields	Drift (ERP Properties)	This caused drift in terms of users not understanding the meaning of important fields and hence not using them

Technology Affordance (Machine Agency)	Result (Control/Drift)	Comments
Constraining users to input moving average price	Drift (ERP Properties, Data Quality)	This caused drift as the moving average price that specified the average price of materials bought from suppliers was not needed in order to check the materials out or transfer them to another site. The system however constrained users to input such a price before materials could be moved.
Having to do 3 different transactions in the system for picking, packing and posting	Drift (ERP Properties)	Drift occurred as all 3 transactions were in essence carried out by one person in one department
Allowing materials to be ordered although service order has been cancelled	Drift (ERP Properties, Lack of system checks)	This meant that control was lost on the interrelationship between the service order and the materials required for the service of the train
Checks for data quality and integrity (format, ranges, etc)	Control (System Checks)	Control that data was input according to specified criteria, such as format, range of values, etc
Not carrying out checks for returning broken items into good stock	Drift (Lack of System Checks)	The system did not carry out checks that items declared as broken were not allowed to be returned back into good stock
No production of professional-looking reports according to company needs	Drift (ERP Properties)	The company had to use other software to produce reports according to their requirements, e.g. Excel or Crystal Reports
Allowing logging of train defects into the system	Control (ERP Properties)	This ensured that the exact nature of work to be carried out on trains could be determined
‘Stamping’ each transaction with the user and date/time	Control (Access Profiles, ERP Properties, Visibility)	This ensured that erroneous transactions could be attributed to a particular user and a particular date/time, if the need arose (visibility of user actions)
Allowing the issuing of warehouse items and billing to be carried out	Control (ERP Properties)	This ensured that whenever an item from the warehouse was issued, it could be billed for appropriately
Not allowing the handling of stock external to the company	Drift (ERP Properties)	Stock not belonging to the company (such as that from Bombardier) could not be accounted for, although the stock resided at the company’s warehouses
Allowing the input of labour and materials needed to carry out a job	Control (ERP Properties)	Control that labour hours and materials could be specified for a job, so that those could be correctly accounted for in terms of billing and stock availability
Not allowing posting of stock discrepancies after two stock-counting periods have elapsed	Control / Drift (System Checks, ERP Properties)	From the control point of view, this ensured that stock discrepancies had to be settled within time limits. From a drift point of view, this could mean that old stock was not accounted for if it was not included within the last two stock-counting periods
Allowing the creation of source lists to specify approved suppliers	Control (ERP Properties)	This controlled that only approved suppliers specified in an administrator-created source list could be used for buying items
Allowing fields in SAP to look mandatory although they are not	Control / Drift (ERP Properties)	From a control point of view, this “tricked” users into believing that they had to enter some values in those fields. From a drift point of view, users could still bypass those fields by not entering values into them

Technology Affordance (Machine Agency)	Result (Control/Drift)	Comments
Disallowing creation of invoices for materials to be used until those have been respectively received from the supplier	Control (ERP Properties, System Checks)	Control that materials from a supplier first had to be received before they could be further used on trains and corresponding invoices created
Allowing the capturing of descriptive information with regards to checks carried out on trains and faults found	Control (ERP Properties)	Control that any faults found on trains during checks could be qualitatively described in the system

Having analyzed and summarized ERP use at Alstom from the viewpoint of the agency (affordance) of the SAP system, the next section summarizes ERP use from the viewpoint of human (user) agency.

5.9.2. Human agency

Identified instances of human agency at Alstom are shown in Table 22 below. The outcome (control and/or drift) is also shown, together with relevant codes from the coding structure shown in Figure 7, as well as comments explaining each identified instance of human agency in the use of SAP in Alstom.

Table 22: Human Agency of ERP users at Alstom

Human Agency	Result (Control/Drift)	Comments
Not setting access profiles appropriately	Drift (Access Profiles)	Drift occurred by giving users less or more access than required, resulting in incomplete use of the system in the former case, and potential abuse in the second case
Setting levels of authorisations for financial data	Control / Drift (Access Profiles)	The correct / incorrect assignment of authorisation levels (as part of access profiles) with regards to the handling of financial data (such as spending limits) respectively contributed towards control / drift from efficiently managing those financial data
Not setting display-only profiles in the Commercials area	Drift (Access Profiles, Bypassing of System Controls)	Drift by users not being able to examine contract and proposal details in case of query, but having to ask other users with full access, in essence bypassing the existing controls in the system
Using one person's login	Drift (Access Profiles, Bypassing of System Controls)	Drift occurred by users bypassing the established controls of the system which were implemented by assigning a username and password to each individual
Not capturing customer details for a contract	Drift (Missing Information)	The lackadaisical maintenance of customer details resulted in not being able to find details for a customer when work was carried out, potentially resulting in loss of revenue

Human Agency	Result (Control/Drift)	Comments
No business rules existing to allow efficient capturing of abnormal work	Drift (Missing Information, Data Quality)	By not inputting or wrongly inputting in the system data relevant to abnormal work (such as nature of defects, hours worked), revenue was lost by not being able to correctly charge the customer for that work
Capturing hours in a text-based descriptive field in service orders	Drift (Missing Information, Interpretive Flexibility)	By wrongly capturing hours worked in a text-based descriptive field in SAP instead of the appropriate numerical one, meant that in essence those hours were not accounted for, as SAP could not do any processing on them
Not closing service orders after work on train has been completed	Drift (Missing Information)	Neglecting to close service orders after work on a train had been completed meant that finance could not charge for this work
Users not using the fields they did not understand	Drift (Missing Information)	Drift occurred by information missing from the system in general, impacting the processing of SAP and other departments
Inputting a fictitious moving average price	Drift (Data Quality)	Although a moving average price was not needed by users in the Materials Management area, the system still required them to input one, therefore the users used to input a fictitious one. This could result in drift if other users (e.g. in the purchasing department) in the future wanted to access and use this moving average price
With regards to picking, packing and posting of items, being forced to carry out all 3 transactions in the system	Drift (ERP Properties)	Drift could occur from the ideal of efficiently carrying out processes, by requiring the user to carry out 3 separate transactions in the system, where one would suffice
Buying materials (inadvertently or intentionally) although corresponding service order has been cancelled	Drift (Lack of System Checks)	Drift could occur by the user buying material connected to a service order, even after the service order had been cancelled in the system
User inputting data according to constraints in the system	Control (System Checks)	General control that users did not input erroneous information (at least with regards to the format and range of values) in the system
Users returning broken items into good stock	Drift (Data Quality)	Drift by the system containing a false portrayal of reality with regards to the stock held and its status
Using Excel or Crystal Reports for the production and manipulation of reports	Drift (Use of External Systems)	Using external systems for the company's reporting requirements meant that data could be generally falsified by users since it did not fall under the access controls of the system
Using Ravers to log defects into the system instead of SAP	Drift (Use of External Systems, Missing Information)	Using another system to log train defects meant that SAP was not kept up-to-date with information on train faults
Using Ravers that did not provide 'stamping' of transactions with user/time/date info	Drift (Use of External Systems)	This meant drift from the ideal of visibility in the system, in terms of being able to see when and by whom transactions were carried out

Human Agency	Result (Control/Drift)	Comments
Using Excel templates to produce warehouse issues and billings	Drift (Use of External Systems, Missing Information)	Carrying out issues and billings in Excel instead of SAP (e.g. for speed of use) although SAP offered the required functionality, meant that SAP was not updated with relevant information. By bypassing the system, drift could occur from the ideal of SAP managing the company's data
Using the Tact system for the handling of external stock, also due to business requirements with suppliers	Drift (Use of External Systems)	Using another external system (Tact) for the maintenance of stock not belonging to Alstom also resulted in not being able to account for all of the stock at the company's warehouses in one system
Not inputting or incorrectly inputting labour or materials needed to carry out a job	Drift (Missing Information, Data Quality)	Human negligence or inaccuracies in the inputting of labour or materials meant that the wrong billing could be carried out
Finance not giving authorisation to post stock differences	Drift (Data Quality)	If two stock-counting periods had elapsed, stock differences could not be posted unless finance gave appropriate authorisation in the system. This was only done when big discrepancies existed, resulting in incorrect portrayal of stock reserves when only small discrepancies existed, and therefore affecting the quality and accuracy of data (regarding stock reserves) held in the system.
Creating new source lists to bypass the administrator-created source lists	Drift (Bypassing of System Controls)	Users could bypass the administrator-created source lists and create new ones of their own in order to specify suppliers they could buy materials from
Making some fields look mandatory by putting a tick next to them	Control / Drift (ERP Properties, Missing Information)	Making some fields look mandatory could "trick" users into believing they had to input values in them. On the other hand, this was very easy to bypass (not inputting the required information) with the appropriate knowledge
Creating manual invoices before materials have been received from a supplier	Drift (Working Outside the System)	Although SAP required that an invoice to a customer could not be generated before corresponding materials have been received from a supplier, users could bypass this by creating manual invoices to a customer
Not inputting detailed information with regards to checks carried out on trains	Drift (Missing Information, Data Quality)	Not capturing detailed information with regards to the output of checks carried out on trains meant that this information was not available later if the company needed to access it

Having described instances of machine and human agencies in the use of SAP in Alstom, the next section describes the interplay between the two types of agency.

5.9.3. Interplay between human and machine agencies

Instances of the interplay between human (user) and machine (ERP) agencies are shown in Table 23 below, together with the outcome of each agency (control and/or drift) as was discussed in Table 21 and Table 22. The interplay between the

two agencies in most of the cases involved the actions that the ERP system enabled or constrained users to take in the system, or the effects of certain system characteristics on the users. In other cases, this interplay entailed the actions of users in the system impacting the further actions that the ERP system could afford. Those aspects of the interplay between human and machine agencies are discussed in the “Comments” column of Table 23 below.

In order to highlight the interplay between human and machine agencies, mostly the drifting actions of human agency (i.e. the users) are shown in Table 23 below. The overall result of the interplay would then also be drift. However, if the drifting actions of human agency did not take place, the overall result of the interaction between human and machine agencies would be the outcome (control/drift) of the corresponding affordances of the ERP system in each row of the table below. In other words, if both the human and machine agencies regarding the use of the ERP system resulted in control, then that would be the outcome of the interactions of the two agencies; if at least one of them resulted in drift, then that would also be the overall outcome of the interactions of the two agencies.

Table 23: Interplay between human and machine agencies at Alstom

Machine Agency	Human Agency	Comments
Setting of Access Profiles (Control)	Not setting access profiles appropriately (Drift)	By not configuring access controls appropriately, this impacted on the actions users were allowed in the system and the data that they could access, which was sub-optimally handled
Allowing different authorisation levels for the handling of financial data (Control)	Setting appropriate levels of authorisations for financial data (Control)	Setting appropriate authorisation levels for the handling of financial data meant that control was established on spending amounts
Allowing display-only access to some screens (Control)	Not setting display-only profiles in the Commercials area (Drift)	Not setting display-only profiles reflected on what users could do in the system, which was sub-optimally handled, especially for the viewing of contracts in the Commercials area
Disallowing display-only access to Materials Master (Drift)	Users had either full or no access to Materials Master (Drift)	Machine agency of SAP disallowing display-only access to Materials Master impacted on the amount of access (none or all) that users had in that area of the system, which could potentially lead to under-use or abuse of the Materials Master functionalities
Allowing different logins to the system (Control)	Using one person's login (Drift)	Using one person's login by all workers in the workshop at Manchester had an impact on the system by not being able to correctly register the originator of transactions
Allowing registration of customer details for a contract (Control)	Not capturing customer details for a contract (Drift)	Not capturing customer details meant that the system could not obtain those for the benefit of other users when needed

Machine Agency	Human Agency	Comments
Allowing capturing of non-contractual requirements (abnormal work) (Control)	No business rules existing to allow efficient capturing of abnormal work (Drift)	Not capturing non-contractual requirements in SAP meant that work done on trains outside contractual obligations of Alstom, could not be charged for
Allowing capturing of hours worked in a service order in relevant fields in SAP (Control)	Capturing hours in a text-based descriptive field in service orders (Drift)	Users not capturing hours worked on a job in the right fields in SAP reflected on the system not being able to carry out calculations on those fields
Allowing opening and closing Service Orders (Control)	Not closing service orders after work on train has been completed (Drift)	Not closing service orders meant that the system could not allow billing for the work specified in the service order
Not containing self-explanatory data labels for fields (Drift)	Users not using the fields they did not understand (Drift)	The perceived by the users unfriendly (complicated) labels of SAP reflected on the users being apprehensive of the system and what various fields meant
Constraining users to input moving average price (Drift)	Inputting a fictitious moving average price (Drift)	Inputting a fictitious moving average price for materials would mean that this was not useful if the moving average price was used in the future by other users (e.g. in the purchasing department)
Having to do 3 different transactions in the system for picking, packing and posting (Drift)	Being forced to carry out all 3 transactions in the system (Drift)	The constraints of the system impacted on the way the users carried out their operations in the system, which was sub-optimally handled
Allowing materials to be ordered although service order has been cancelled (Drift)	Buying materials (inadvertently or intentionally) although corresponding service order has been cancelled (Drift)	Inefficient system checks that materials should not be bought when relevant service orders had been cancelled meant that users could (intentionally or unintentionally) exploit this inefficiency
Checks for data quality and integrity (format, ranges, etc) (Control)	User inputting data according to constraints in the system (Control)	System constraints on the format and range of data input reflected on users having to conform with those constraints
Not carrying out checks for returning broken items into good stock (Drift)	Users returning broken items into good stock (Drift)	Not checking for status of stock by the system meant that users could abuse this (intentionally or unintentionally) and return declared broken items into good stock in the system
No production of professional-looking reports according to company needs (Drift)	Using Excel or Crystal Reports for the production and manipulation of reports (Drift)	Not producing reports according to company specifications reflected on the company having to use external software, where data could be manipulated
Allowing logging of train defects into the system (Control)	Using Ravers to log defects into the system instead of SAP (Drift)	Although SAP allowed logging of train defects, business requirements with customers meant that those were recorded in other rail industry standard systems accessible by customers, which reflected negatively on the accuracy and timeliness of data in SAP

Machine Agency	Human Agency	Comments
'Stamping' each transaction with the user and date/time (Control)	Using Ravers that did not provide 'stamping' of transactions with user/time/date info (Drift)	Similarly, using external rail industry standard systems (such as Ravers) which did not record the user and date/time of transactions, meant that this information was not available if the need arose
Allowing the issuing of warehouse items and billing to be carried out (Control)	Using Excel templates to produce warehouse issues and billings (Drift)	Using external software (Excel) for the carrying out of operations supported by the system meant that the system was not up-to-date with the necessary information, or was totally missing important information
Not allowing the handling of stock external to the company (Drift)	Using the Tact system for the handling of external stock, also due to business requirements with suppliers (Drift)	Business requirements and SAP inabilities necessitated the use of external systems for the handling of stock not belonging to the company but residing in its warehouses, resulting in a unified picture of the stock at the company's warehouses not being available
Allowing the input of labour and materials needed to carry out a job (Control)	Not inputting or incorrectly inputting labour or materials needed to carry out a job (Drift)	Lack of or incorrect information input reflected on the system not being able to correctly account for job requirements in terms of labour or materials
Not allowing posting of stock discrepancies after two stock-counting periods have elapsed (Control, Drift)	Finance not giving authorisation to post stock differences (Drift)	If two stock-counting periods had elapsed and the stock differences were not substantial, finance would not give authorisation to carry out stock adjustments, resulting in an erroneous picture of available stock in the company, therefore affecting the quality of data (regarding stock reserves) in the system
Allowing the creation of source lists to specify approved suppliers (Control)	Creating new source lists to bypass the administrator-created source lists (Drift)	Creating new source lists specifying approved suppliers had an impact on which suppliers users could buy goods from, apart from the ones specified by the administrator in the system
Allowing fields in SAP to look mandatory although they are not (Control, Drift)	Making some fields look mandatory by putting a tick next to them (Control, Drift)	Making fields look mandatory reflected on the perception of end users regarding those fields, forcing them to input important data (control), or users realizing that fields are not actually mandatory and therefore not inputting the relevant data (drift)
Disallowing creation of invoices for materials to be used until those have been respectively received from the supplier (Control)	Creating manual invoices before materials have been received from a supplier (Drift)	Creating manual invoices meant that the system did not hold accurate data with regards to company's operations
Allowing the capturing of descriptive information with regards to checks carried out on trains and faults found (Control)	Not inputting detailed information with regards to checks carried out on trains (Drift)	Not inputting detailed information in the system would have an impact when other users wanted to look up this information

Having described the interplay between human and machine agencies in the use of the SAP system in Alstom, the next section further refines human agency according to the concepts of embedding/disembedding.

5.9.4. Embedding-disembedding of human agency

Disembedding of human (user) actions in SAP occurred through the actions impacting on contexts outside the immediate area where they were carried out. Reembedding of human actions occurred through the use of disembedded actions by users in other contexts, i.e. in other functional areas of the system and/or other geographical locations. This would mean that an action of a user in the system would impact other users of the system, in a cause and effect, or action/consequence manner.

However, the employment of the disembedding/reembedding concepts goes a step further from simply describing cause and effect. Due to the global and integrative nature of the ERP system, the action of a user in the system was not simply the cause for another action by another user, but also entailed visibility across geographical, functional and time dimensions. This meant that the disembedded action in the system was recorded, and could be examined by authorised users in other locations of the company, in other functional areas, or in the future if need arose. This action was therefore no more local, but was “disembedded” across time and space.

The disembedding and reembedding of human actions in the system was facilitated by the machine agency of the ERP system. For example, the fact that the ERP system consisted of a single global database enabled the user actions to be disembedded in terms of being visible to other users. The single database also enabled other users to view disembedded actions in the system and reembed them, in terms of using them as the input for their own work. The disembedding and reembedding of human actions was also facilitated by the workflow and access controls in the ERP system, which specified which actions users could take in the system in order for them to be disembedded, and to which other users those actions would impact upon, in terms of those actions being reembedded by them.

Instances of observed disembedded and reembedded human actions are summarized below. The actions described in the table below also include inactions, in terms of the users not performing an operation on the system.

Table 24: Embedded and disembedded human actions at Alstom

Disembedded Human Action	Reembedded Human Action	Comments
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Disembedded Human Action	Reembedded Human Action	Comments
Cancelling service order	Purchasing materials although service order has been cancelled	An example of drift resulting from the disembedded action of cancelling a service order, followed by the reembedded action of purchasing materials, afforded by the agency of the ERP system
Not closing service orders when work is completed	Finance not being able to bill for service orders which have not been closed	The inaction of not closing a service order at the service department was disembedded to users in the finance department, who could not reembed the result of closing the service order, in order to be able to bill the customer for the work done
Defining the wrong task list in a service order	Allocating incorrect resources to carry out a job	If the wrong task list detailing work to be done on a train was defined in a service order by production planners, this would be disembedded to team leaders at the production workshop. Those would be consequently reembedding this task list for allocating resources to do the job, which would be wrong if the task list was defined incorrectly
Not capturing contract particulars for a contract with a customer	Finance cannot bill for work carried out	If users at the sales department failed to accurately capture contract details in the system, this would be disembedded to all users with a right to access this contract. In particular, when the finance department would reembed the details of this contract, they would not be able to bill for work carried out under this contract
Using Excel templates to produce warehouse issues and billings	Finance cannot account for the billings done outside the system	The user action (inaction) of not using the system to produce item issues and billings would be disembedded to all users dealing with issues and billings. The finance department in particular would not be able to reembed the outcome of those user actions outside the system in order to account for the relevant billings
Not inputting or incorrectly inputting labour or materials needed to carry out a job	Finance charges incorrect amounts to customer	If labour and materials were defined incorrectly in the system, they would impact finance who would not be able to charge the right amounts to the customer
Finance not giving authorisation to post stock differences	Materials Management cannot post stock differences	The action (inaction) of finance of not giving authorisation to post stock differences in the system after two stock-counting periods had elapsed, would be reembedded by users at the Materials Management area, who would not be able to post those stock differences
Creating manual invoices before materials have been received from a supplier	Finance cannot account for invoice until it has been retrospectively entered into the system	The inaction of creating invoices in the system (but creating manual invoices outside the system instead) would be disembedded to the finance department, who would not be able to charge the customer accordingly

Disembedded Human Action	Reembedded Human Action	Comments
Central Fleet Control not putting detailed information with regards to train faults in SAP	Production department cannot allocate resources beforehand	The inaction of Central Fleet Control in putting detailed information about train faults as they received them from the driver meant that the production department could not reembed this information in order to allocate resources needed to fix the train
Not inputting detailed information with regards to checks carried out on trains	History of checks and work carried out could not be determined if need arose	Not inputting detailed information in the system regarding checks on trains meant that such information could not be reembedded if the history of checks needed to be checked

In the table above, the outcome of the disembedding and reembedding actions in the system is assumed to be drift, by looking at the consequences of not carrying out an action in the system, or carrying out the wrong one. The disembedding and consequent reembedding of this action as indicated by the examples in the table above would then lead to drift. However, assuming that the right action was carried out in the system and this was reembedded appropriately, then control would be re-enacted.

For example, the disembedded action (inaction) of leaving a service order open would be reembedded by Finance in terms of not being able to bill for that service order, resulting in drift. However, assuming that the service order was closed appropriately, this action would be disembedded to the Finance department, who would be able to reembed it in terms of charging the customer for the work carried out. In this case control would be re-enacted, as the company would be able to bill the customer for work carried out.

Based on the analysis of the findings from Alstom on the dimensions of human/machine agencies and their interplay, as well the embedding/disembedding of human actions described above, the next section conceptualises the findings on those dimensions.

5.9.5. Conceptualisation of ERP use

Figure 16 below presents the conceptualisation of ERP use at Alstom, and the relationship with organizational control and drift. The case study indicates that the organizational mandate for installing SAP was to increase control over the company's operations. Alstom recognized that in order to achieve this, training (including the production of SAP manuals) and a global IT department taking responsibility over SAP were important. However, in the end inefficient or lack of training meant that Alstom drifted in its intention of using SAP to control its operations. This was evident in the use of SAP by its users, who due to lack of training could not use the system efficiently to achieve the company's

organizational goals. This also implied a degree of resistance to the system by not using it. A perceived unsuccessful implementation, especially for PartsLink at Preston, also resulted in suboptimal configuration and use of the system, which also implied drift.

Power differentials in terms of users gaining experience of SAP during its implementation and then becoming perceived experts in the company could also impact the use of the system. This was by simple users bypassing the helpdesk (BPnGIS team) and instead seeking the help of the perceived expert users whenever they encountered problems with the system. By doing so however, drift could be propagated as the problems of users were not logged in the helpdesk, and therefore could not be analyzed with regards to training needs or changes required to the system.

Power differentials impacting the use of the system were also observed from the tensions between the BPnGIS team in Birmingham and the ITC team in Paris. The BPnGIS team had to follow the mandates by ITC in all cases where SAP was concerned, including the setting of access profiles and the configuration of the SAP functionality where needed. However, although UK users had quite a lot of problems in using the system due to perceived inadequate training and incorrect access to the system (via their access profiles), the BPnGIS team could not help them as they did not have the sanctioning from ITC, who had power over the functioning of the BPnGIS team. As a result, there were at many times tensions between the users and the BPnGIS team, as well as between the BPnGIS team and the ITC team in Paris. The result in the end however was drift with regards to the efficient use of the system by its users.

Regarding the actual use of the system, the interaction amongst users in the system was explained using the concepts of disembedded and reembedded actions. Disembedded user actions (or inactions) referred to data inputs in the system by users. Because of the shared database of the system and its deployment across various company locations, such data input meant that the data was “disembedded” to other users of the system, in terms of becoming available to them. This data in turn was “reembedded” by those users, by using it as input for their own work. Because of the workflow inscribed in the ERP system, the disembedding and reembedding of information could be seen to operate in cycles, i.e. the output of one phase of the workflow being used as the input in the next phase of the workflow.

In addition, as has been shown with the other companies examined, there was an interplay between the human (user) and machine (human) agencies. This meant that actions that users could take in the system depended on what the system afforded to them, but on the other hand the system was dependent on users using it correctly (e.g. inputting the right information in the right fields) in order to be able to function correctly.

The actual use of the system by its users according to the capabilities that the system offered could result in either control or drift. Control was seen to arise from the visibility of user actions in the system, as well as the access profiles that could be defined in the system. In addition, the capability of the system to perform checks for data consistency, as well as other ERP properties meant that control was also exercised.

On the other hand, use of external systems (such as Excel, Ravers, etc) which did not fall under the same access controls as SAP, meant that data could be falsified, or not be in accordance with the data in SAP, resulting in drift from using SAP to efficiently manage the company's data. The incorrect setting of access profiles also meant that users could either abuse those profiles or not being able to use the system efficiently. Drift could also occur because of users inputting the wrong (or no) data in the system, bypassing with various means the intended controls in the system (e.g. creating new source lists or using one person's login), or actually working outside the system (e.g. when producing manual invoices). From the system's point of view, its inability to perform certain important checks for data accuracies (e.g. for returning broken stock into goon one) also meant that drift could occur. As well as various other ERP properties resulting in drift, users could also exercise their interpretive flexibility when using the system, for example by using descriptive text fields instead of the appropriate numerical fields in order to capture important operational information (e.g. labour hours pertaining to a service order). By doing so, the company would drift from the ideal of efficiently capturing and managing its operational data, as using the wrong fields would mean that no further processing could be done on them.

Figure 16 below presents the conceptualisation of ERP use at Alstom, and the outcomes of control and drift. The contextual factors impacting ERP use (in the form of pre-existing control / drift) as well as the outcomes of ERP use (control / drift) follow from the coding scheme of the 2nd pass of coding (shown in Figure 7) that was applied on the interview data. As drift in many cases could be seen as the opposite of control, this would mean that if a control or drift factor was not correctly applied, then the opposite result to control or drift would occur. For example, although access profiles are shown as a control factor in Figure 16 below, their incorrect setting or bypassing by the users would mean that drift would occur. Similarly, although data quality is shown as a drift factor (when data quality is sub-optimal), it can also be a control factor when the quality of the data in the system is satisfactory.

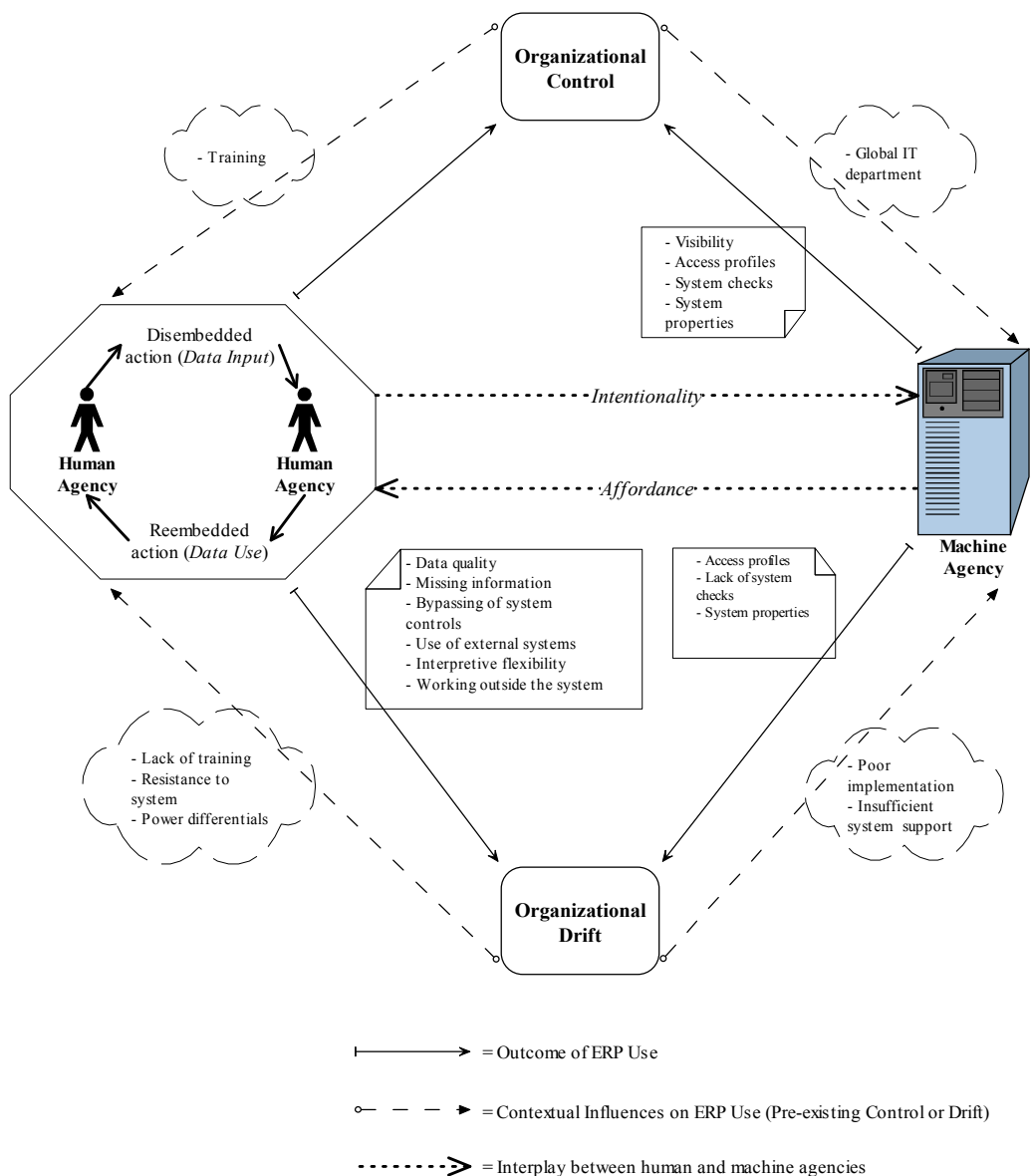


Figure 16: Conceptualisation of ERP use at Alstom

A detailed comparison of the findings from Alstom and the four auxiliary cases is carried out in chapter 6, after discussing the themes emerging from the examination of the case study companies. The next section however summarizes the findings from Alstom and the knowledge that was added by its examination.

5.10. Summary of Findings and Knowledge Added

Similarly to Chubb Fire, training was regarded as very important in achieving the efficient use of the system in Alstom. The issue of training was examined in much more detail in Alstom, however, and the many problems associated with the lack of training were discussed. Training in that sense was a contextual factor promoting control over the use of the system if it was carried out efficiently, and promoting drift otherwise as users would not be able to use the system effectively if training was missing or was inadequate.

In addition in Alstom, the presence of a global IT department was deemed as important in promoting control over the use of the system. Similarly to Chubb Fire again, resistance to the system was also seen as a contextual factor promoting drift regarding the use of the system. In addition in Alstom however, other contextual factors promoting drift were the perceived poor implementation of the system in some areas (e.g. in the PartsLink business at Preston), as well as the power differentials which were created as a side effect from the implementation of the system. The last point is in contrast to Chubb Fire, where the creation of power differentials was done deliberately, with the aim of actually increasing control over the use of the system.

When it came to the actual use of the system, the initial findings from the first four case study companies were confirmed and elaborated in much more detail in Alstom. Those included the visibility offered by the system, the access profiles afforded by the system, as well as various system checks and properties, all of which were seen to promote organizational control from the use of the ERP system.

Also similarly to the first four companies examined, the use of external systems, the quality of data in the ERP system, various system properties and working outside the system (manually) were interpreted as drift from the use of the ERP system, and those aspects were elaborated in detail in Alstom. The examination of Alstom also contributed to the knowledge that the interpretive flexibility of users in the system and the bypassing of system controls also contributed towards drift from the use of the system. Lack of system checks, the abuse of incorrectly set access profiles and the lack of important information input in the system also meant that drift was propagated from the use of the system, and those aspects were discussed in length in the case study of Alstom.

Having discussed and analyzed Alstom in this chapter, as well as the initial four companies in chapter 4, the next chapter discusses and compares the findings in more detail, presents their implications for theory and practice, as well as the limitations of this research and potential for future research.

6. Discussion and Conclusions

6.1. *Introduction*

The previous two chapters analyzed and discussed the auxiliary companies of Multiyork, Chubb Fire, NTL and Reuters (in chapter 4) as well as the main case study of Alstom (in chapter 5). The purpose of this chapter is to discuss the results of the examination of the case study companies. Wherever possible, comparisons are made amongst the examined companies, if there are data to facilitate those. The emerging themes from the examination of the case study companies are presented in section 6.2. The discussion is then centred in section 6.3 on the research questions of this study, in order to show how those were addressed by the examination of the case study companies. Section 6.4 presents the contributions of this research (practical and theoretical), while section 6.5 discusses the limitations of the research, and section 6.6 the potential for future research. Section 6.7 presents the thesis' concluding remarks.

6.2. *Emerging Themes*

6.2.1. Human and machine agencies

The actual use of the system in the analysis of the five companies was conceptualised by the interplay between human and machine agencies. The system in this case enabled or constrained users to take some actions in the system, in terms of data input or data use. These actions then reflected back to the system, in terms of the next steps the system could allow.

In conceptualising the interplay between human (user) and machine (ERP system) agencies the differences between the two agencies were implicitly held in consideration, according to the discussion in section 2.8.1, and the development of the concept of human and machine agencies in Figure 2. A human agency position in the use of the ERP system in this case assumed that humans (ERP users in this case) could choose to use the system minimally, invoke it according to needs, or improvise in ways that could produce unanticipated consequences (Boudreau and Robey, 2005; Orlikowski, 2000). On the other hand, machine agency was assumed to embody rules guiding human action, limiting choice alternatives and monitoring human action (Boudreau and Robey, 2005; Winner, 1977; Zuboff, 1988). Although machines themselves are products of human agency (when the development stage is considered), when they are installed and left to operate they then become constraints or enablers of human agency (Boudreau and Robey, 2005; Nandhakumar et al., 2005; Rose et al., 2003).

In other words, the assumption in the handling of agency in this thesis was that human (ERP user) agency was characterised by intentionality to perform certain actions in the system, while machine (ERP system) agency was characterised by affording (enabling or constraining) the intended human (user) actions in the system. This position followed amongst others the works of Jones (1999a), Rose and Jones (2005) and Rose et al. (2003), who argue that by defining agency as the “capacity to make a difference” (Giddens, 1984), both machines and humans can be viewed as possessing agency. However, humans have intentionality and self and social awareness, which result in capabilities for interpretation of particular situations and actions. Machines however lack those capabilities (at least to a large degree relative to humans and based on current technologies). In the interplay between human and machine agencies then, while humans can interpret the actions of the machine, the machine does not have the ability to do so, but can only register human actions and provide “rule-based” or “learned” responses to them (Rose and Jones, 2005).

6.2.2. Embedding-disembedding of human agency

Human agency was also further elaborated (mainly in Alstom and also in Reuters to a lesser degree) into the disembedding and reembedding of user actions in the system, in the way that actions of one user were disembedded to other users, and these actions then being reembedded by them as input for their own work in the system. The disembedding of actions in this case was linked to data input by users in the system, and the reembedding of actions was linked to data use by users of the system. Because of the single database of the system enabling visibility of user actions, as well as the interdependencies of user actions enabled by the workflow inscribed in the system, the disembedding and reembedding of user actions were seen to operate in cycles. This meant that the output of a user action in the system was the input for an action by another user in the system.

6.2.3. Control and drift as contextual factors impacting ERP use

From the examination of the case study companies a number of factors impacting on the use of the ERP system were identified. These factors were classified as either pre-existing organizational control or drift impacting the use of the system. This impact could be on the users of the system, or on the ERP system itself, as the table below summarizes. The way that the identified contextual factors impacted on the use of the system is shown in the “Remarks” column of the table below.

Table 25: Contextual factors impacting ERP use

Contextual Factor	Classification (Control/Drift)	Impact on	Remarks
Training	Control/Drift	Human Agency (Users)	Training was found to be very important in the correct use of the system by its users. If training was lacking (e.g. in Alstom), then drift would occur as the system would not be used appropriately.
Power Differentials	Control/Drift	Human Agency (Users)	Power differentials ensured that the system was used correctly if they were deliberately created (as in the case of operational champions in Chubb Fire). In the opposite case, power differentials created drift as users could abuse their increased knowledge or access to the system, and this could impact other users (as in the case of the perceived SAP experts in Alstom).
User Empowerment	Control	Human Agency (Users)	Perceived user empowerment in terms of users maintaining their own

Contextual Factor	Classification (Control/Drift)	Impact on	Remarks
			personal records (as in the case of Reuters) was seen to increase control over the user's data.
Resistance	Drift	Human Agency (Users)	Resistance to the system meant that the system was sub-optimally used by its users.
Legislation	Control	Machine Agency (ERP)	The need to adhere to legislation meant that the system had to be configured to accommodate the relevant legislative requirements (as in the case of adherence to SOX in Chubb Fire and Reuters).
Standardisation	Control	Machine Agency (ERP)	The need for standardisation of data and processes meant that the system had to be able to offer the relevant functionalities.
Global IT Department	Control	Machine Agency (ERP)	The presence of a global IT department (e.g. in Alstom with ITC in Paris and in Reuters with the Business Service Centres) meant that better control over the functionality of the system could be exercised.
Integration of ERP Functionalities	Control/Drift	Machine Agency (ERP)	More integration of the level of functionalities offered by the ERP system meant the more control over the company's data and processes could be exercised. Less integration was in some cases intentional, however (as in the case of NTL), which meant that a degree of drift was necessary.
Poor Implementation	Drift	Machine Agency (ERP)	A perceived poor implementation of the ERP system (as in the case of the PartsLink business in Alstom) meant that the system could not offer the functionalities needed for efficient use.
Insufficient System Support	Drift	Machine Agency (ERP)	Perceived insufficient system support apart from training (as in the case of Alstom) meant that the system was sub-optimally configured (e.g. in the setting of access profiles) which would result in the system not offering the required level of functionalities to its users.

While the above identified factors are classified as either organizational control or drift impacting the use of the ERP system, this classification follows the interpretation of the researcher and is relative to the unique context of the companies examined. It must be mentioned that this classification may sometimes be quite subtle, in the sense that the same contextual factor may be classified as control in one organizational context, but as drift in another. Although for example

a perceived “poor implementation” history of an ERP system, or “insufficient system support” would be seen by most companies as drifting from the objective of efficiently being able to control the use of the ERP system, other factors may be not so clear to classify. For example, although resistance is classified as a drifting factor impacting the use of the ERP system, in other contexts it could be argued that resistance is a means to alert with specific problems with the system (Kavanagh, 2004; Marakas and Hornik, 1996; Markus, 1983), therefore it could be seen as a control factor signalling potential problems with the ERP (technical and/or business-oriented). Similarly the case with user empowerment, although it is classified as a control factor in the above table, it could also be argued that by users having too much authority in the system, control could be diminished, and therefore empowerment could act as a drifting factor. Regarding power differentials, those for example have been classified as either control or drift impacting the use of the ERP system, depending on the way those power differentials were created and the context where they were applied.

As such, the interpreted nature of the classification of contextual factors as either control or drift must be mentioned. In reality, this classification is better viewed as a continuum of control to drift, and the actual classification carried out in Table 25 above is the interpretation of the researcher according to the unique company context where those factors were identified.

Although the above identified contextual factors were seen from the point of view of their impact on the *use* of the ERP system, the next section contrasts those factors with the literature-cited Critical Success Factors (CSFs) for ERP *implementation*.

6.2.3.1 Comparison of contextual factors impacting ERP use with critical success factors for ERP implementation

The literature has cited a plethora of Critical Success Factors that can affect the success or failure of the implementation of an ERP system in a company (e.g. Akkermans and van Helden, 2002; Al-Mashari and Al-Mudimigh, 2003a; Bancroft et al., 1997; Bingi et al., 1999; Holland and Light, 1999; Nah et al., 2001; Sarker and Lee, 2003; Shanks et al., 2000; Skok and Legge, 2001; Somers and Nelson, 2001; Umble et al., 2003). Relevant literature has been presented in section 2.3.2.3 of this thesis. Although these success factors can have an impact during the *implementation* of an ERP system, some of these factors may also have a related impact during the actual *use* of the ERP system, post-implementation. The factors impacting ERP *use* (as opposed to *implementation*) were therefore examined in this thesis, and were contextual in nature (i.e. according to the organizational context where they were identified). These contextual factors were developed bottom-up from the collected data, and were not driven by the literature on Critical Success

Factors however, as this literature referred to the *implementation*, and not the *use* stage of ERP systems.

Although therefore the literature-cited Critical Success Factors for ERP implementation and the contextual factors impacting ERP use developed in this thesis are not the same, a high-level comparison between the two to note their potential similarities and differences could be carried out. This is done in the table below. The purpose is not to present an exhaustive list of all the Critical Success Factors for ERP implementation mentioned in the literature and compare them one by one with the contextual factors for ERP use developed in this thesis. Rather, the purpose of the table below is to examine whether the contextual factors that were identified bottom-up from the examination of the case study companies have any correspondence with the literature-cited CSFs for ERP implementation. As such, only the literature-cited CSFs that may have any correspondence with the contextual factors developed in this thesis are examined.

Table 26: Comparison of literature-cited CSFs for ERP implementation with contextual factors impacting ERP use developed in this thesis

Authors	Literature-cited Critical Success Factor for ERP Implementation	Contextual Factor Impacting ERP Use (Developed in this Thesis)	Remarks
(Al-Mashari and Al-Mudimigh, 2003a; Bancroft et al., 1997; Bingi et al., 1999; Shanks et al., 2000; Skok and Legge, 2001; Somers and Nelson, 2001; Umble et al., 2003)	Training	<i>Training</i>	As expected, user training was cited as a Critical Success Factor by most authors regarding the implementation of an ERP system, and was also observed in this thesis to be an important contextual factor during the actual use of the system in order to make sure that the users knew what they were doing in the system and how this would impact other users.
(Akkermans and van Helden, 2002; Al-Mashari and Al-Mudimigh, 2003a; Bancroft et al., 1997; Bingi et al., 1999; Holland and Light, 1999; Nah et al., 2001; Sarker and Lee, 2003; Shanks et al., 2000; Skok and Legge, 2001; Somers and Nelson, 2001; Umble et al., 2003)	Top Management Support, Project Champion	<i>Power Differentials</i>	In the literature on Critical Success Factors for ERP implementation support by top management and a project champion were cited as important for the success of ERP implementation. These two success factors implied increased power differentials by some managers to be able to support and drive the project. After implementation and during the use of the system, power differentials by managers driving the use of the system at Chubb Fire were seen to increase control over the use of the system.
(Bingi et al., 1999; Shanks et al., 2000;	Influence of Consultants	<i>Power Differentials</i>	The power of consultants to impose the way in which the system was to

Authors	Literature-cited Critical Success Factor for ERP Implementation	Contextual Factor Impacting ERP Use (Developed in this Thesis)	Remarks
Skok and Legge, 2001; Somers and Nelson, 2001; Umble et al., 2003)			be developed was mentioned by many authors citing Critical Success Factors for ERP implementation. In this thesis it was also noted that in Alstom internal users who actually worked with the consultants during the implementation were subsequently viewed as “experts” by acquiring the knowledge of the consultants. As a result, their power in the company also increased by other users seeking their advice regarding matters of ERP use, and this was seen to decrease the envisaged centrality of control over the use of the system.
(Bancroft et al., 1997; Nah et al., 2001; Sarker and Lee, 2003)	Balanced and Empowered Business and IS Team	<i>User Empowerment</i>	At the implementation stage of an ERP system, a balanced and empowered business and IS team was mentioned in the literature to be a Critical Success Factor for the implementation. After implementation, empowering users to use the system to manage their own employee records at Reuters was seen to be enhancing control over these records. As has been mentioned in section 2.8.6.2 however, empowerment is a contested concept, but in the current context referred to giving users more tasks to carry out in the system.
(Holland and Light, 1999)	Client Acceptance	<i>Resistance</i>	Holland and Light (1999) mention the acceptance of the company (client) as an important criterion determining the success of implementation. In this thesis the ERP system installed at Alstom was not accepted by many members as they saw it as not very user-friendly and not very critical for their operations, which could be carried out using alternative systems such as rail industry standard ones and Excel. As such, their resistance to the ERP system was seen mainly as hindering efforts to successfully adopt the system (Kosseck et al., 1994; Martinko et al., 1996).
-	-	<i>Legislation</i>	Legislation (such as Sarbanes-Oxley

Authors	Literature-cited Critical Success Factor for ERP Implementation	Contextual Factor Impacting ERP Use (Developed in this Thesis)	Remarks
			act) was not mentioned as a Critical Success Factor in the literature on the implementation of ERP systems, but was found to influence the way the system was configured, and consequently used, in this thesis.
(Nah et al., 2001; Shanks et al., 2000; Somers and Nelson, 2001)	Minimal Customization	<i>Standardisation</i>	Minimal customization was mentioned in the literature as one of the Critical Success Factors that could impact the success of implementation of an ERP system. Most of the companies examined in this thesis also mentioned that standardising their data processes by using existing ERP functionalities helped them gain better control over their data and processes.
(Somers and Nelson, 2001; Umble et al., 2003)	Data Accuracy	<i>Standardisation</i>	Similarly, the accuracy of data being converted from older systems and entering the ERP system during the implementation phase was also mentioned as a success factor. As has been mentioned above, the standardisation of such data was also found in this thesis to be an organizational control factor that dictated how users should be interacting with the system in order to maintain the required control over the company's data and processes.
(Skok and Legge, 2001; Umble et al., 2003)	International Dimension, Multi-site Issues	<i>Global IT Department</i>	Taking into consideration the international dimension (cultural differences) as well as differences between different sites was mentioned in the literature to be an important factor determining the success of implementation of an ERP system. A balance between global standardisation and local optimisation was also advocated (Umble et al., 2003). This thesis has found that a global IT department overseeing the use of the system (in Alstom and Reuters) was also conducive to control over the use of the system.
(Al-Mashari and Al-Mudimigh, 2003a; Bingi et al., 1999; Nah et al., 2001)	Systems Integration	<i>Integration of ERP Functionalities</i>	Another critical success factor for the successful implementation of an ERP system mentioned in the literature was the integration of the ERP

Authors	Literature-cited Critical Success Factor for ERP Implementation	Contextual Factor Impacting ERP Use (Developed in this Thesis)	Remarks
			system as a backbone with other systems existing in the company. In this thesis the integration of functionalities was seen to be conducive to the companies' goal of control in most cases, except in NTL, where too tight integration was seen to be contrary to the company's continuous engagement in mergers, acquisitions and sell-offs.
	All Literature-mentioned Critical Success Factors for ERP Implementation	<i>Poor Implementation</i>	A perceived failure of implementation of an ERP system could be attributed to one or more of the critical success factors described in the literature. Naturally, such a failure or poor implementation was found in this thesis to impact the use of the system (if it wasn't discarded), as for example was the case with the perceived poor implementation of SAP at the Parts Business in Alstom.
(Akkermans and van Helden, 2002)	Vendor Support	<i>Insufficient System Support</i>	Vendor support was mentioned by Akkermans and van Helden (2002) as a factor that could influence the success of implementation of an ERP system. At the use stage, the insufficiency of support of the ERP system (by management or the IT department) was also found to be impacting the use of the system in Alstom.
(Akkermans and van Helden, 2002; Al-Mashari and Al-Mudimigh, 2003a; Bancroft et al., 1997; Bingi et al., 1999; Holland and Light, 1999; Nah et al., 2001; Sarker and Lee, 2003; Shanks et al., 2000; Skok and Legge, 2001; Somers and Nelson, 2001; Umble et al., 2003)	Top Management Support	<i>Insufficient System Support</i>	Similarly to the above and as has already been mentioned, top management support was mentioned by most authors as a Critical Success Factor for the success of implementation of an ERP system. System support at the use stage would then refer not only to the top management, but also to the IT department, middle managers and users, as the results from Alstom have indicated.

Having classified the different contextual factors impacting ERP use developed in this thesis, and having compared these factors with the literature-cited Critical

Success Factors for ERP implementation, the next section presents the emerging from the research data theme of organizational control and drift, this time as an *outcome* of ERP use.

6.2.4. Control and drift as outcome of ERP use

As a result of the actual use of the system, organizational control or drift was interpreted to arise, either from the actions of users in the system, or from the affordances of the ERP system. Several factors leading to either result were elaborated, as the table below summarizes.

Table 27: Outcome of ERP use

Actor	Factor	Outcome (Control/Drift)	Remarks
Human (User)	Data Quality	Control/Drift	The quality of data entered in the system by the users had a direct relevance to whether the envisaged control over the company's data was re-enacted or not.
Human (User)	Working Outside the System	Control/Drift	Working outside the system was seen either as extra control over the company's data (e.g. with manually checking financial data in Reuters), or as drift (in terms of the system not being updated with the required data, e.g. with the creation of manual invoices in Alstom).
Human (User)	Missing Information	Drift	Similarly to data quality, if data were not entered in the system by its users this would mean loss of control over the data that needed to be held in the system.
Human (User)	Bypassing of System Controls	Drift	Finding workarounds in the system (as identified in Alstom, e.g. for the materials master and the source lists) meant that drift over the system processes would occur.
Human (User)	Use of External Systems	Drift	Using systems outside the ERP for the manipulation of data coming from the ERP (the commonest example being Excel in all of the companies, as well as rail industry standard systems in Alstom) meant that data could be manipulated and this would be more difficult to detect than directly inside the ERP system.
Human (User)	Interpretive Flexibility	Drift	Users exercising their interpretive flexibility in the system (e.g. inputting numerical data in descriptive text fields in Alstom) meant that control over the accurate handling of those data would be lost.

Actor	Factor	Outcome (Control/Drift)	Remarks
Machine (ERP)	Access Profiles	Control/Drift	The level of access to the system offered by the corresponding user access profiles would contribute to organizational control or drift, depending respectively on whether the level of access to the required data and processes in the system was perceived as right or not.
Machine (ERP)	Systems Checks	Control/Drift	Various systems checks (or lack of) for data and process accuracy would contribute to organizational control (drift) over the corresponding data and processes.
Machine (ERP)	System Properties	Control/Drift	Similarly, various system properties and functionalities (or lack of) that would meet (or not meet) required business needs would contribute to organizational control (drift) over the way the company was aided by the use of the system.
Machine (ERP)	Visibility	Control	The visibility of user transactions offered by the system meant that better control (horizontally and upwards) could be exercised over those transactions and the relevant data.

Although the factors from ERP use in the table above are shown to lead to organizational control and/or drift, this result is in essence the interpretation of the researcher according to the unique context where these factors were identified. The impact of some factors such as data quality, working outside the system, access profiles, systems checks and system properties was interpreted to lead to either organizational control or drift. This depended on the unique characteristics of those factors, also depending on how those factors were applied (as explained in the “Remarks” column of the table above). Other factors however were interpreted to lead to only organizational control, or only organizational drift. For those factors however it must be mentioned that this interpretation depended on the observed impact of those factors on the particular companies examined. It can be argued for example however, that the same factors could be interpreted in another way in a different context.

For example, while missing information was interpreted as resulting in organizational drift, it could be argued that such missing information was the outcome of users not inputting the required information in order to signal problems with the system or data incompatibilities, and this could be viewed as a control factor (e.g. Kavanagh, 2004; Marakas and Hornik, 1996; Markus, 1983). Similarly, while interpretive flexibility was interpreted to result in organizational drift, in other contexts it could be argued that by users adapting the system to their own preferences and interpretations (Boudreau and Robey, 2005; Cadili and Whitley, 2005; Orlikowski, 2000) work could be carried out better, therefore leading to organizational control. Or as another example the case of the visibility of user

actions afforded by the ERP system which was interpreted to lead to organizational control, in other contexts it could potentially lead to users resisting the system. In this sense, some users in Alstom have expressed their perception of the visibility offered by the ERP system as a kind of “Big Brother”. Although those users were subsequently educated and trained to use the system, the visibility functionality of the ERP system could otherwise potentially result in user resistance which would be detrimental to the company (Kossek et al., 1994; Martinko et al., 1996), and which would therefore cause organizational drift as far as the use of the system is concerned.

As such, the interpreted nature of the factors from ERP use leading to either organizational control or drift must be mentioned, which depends on the context where those factors are encountered. Similarly to the contextual factors impacting ERP use, the factors from ERP use leading to organizational control or drift are then better seen as a continuum of control to drift, and their actual classification in an interpretation exercise based on the actual context where these factors are encountered.

The identified themes emerging from the research data and presented in the previous sections also enabled the conceptualisation of the use of an ERP system, which is presented next.

6.2.5. Conceptualisation of ERP use

From the analyses carried out in each of the companies examined, Figure 17 below is a conceptualisation of ERP use and its impact on control and drift, also taking into account factors (contextual influences in the form of pre-existing organizational control and drift) impacting its use. The control and drift factors are a synthesis of the ones found in each of the five companies examined.

The importance of this conceptualisation does not lie in enumerating the various factors affecting ERP use, as well as the factors from ERP use leading to either control or drift. The importance of the conceptualisation lies more in sensitizing the reader with regards to the need to examine the context where an ERP system is used, as well as the actual use of the system and its outcome in terms of organizational control and drift. This means that when examining the use of an ERP system, the factors impacting its use must be examined, as well as the affordances of the system, the actions of users in the system, and the interdependencies between actions of different users (through the disembedding and reembedding of those actions).

In the diagram below the factors from ERP use (shown with the rectangular note shapes) resulting in organizational control or drift, as well as the contextual factors

impacting ERP use (shown with the cloud shapes), are shown to be classified discreetly as *either* control *or* drift. However, as has been mentioned in sections 6.2.3 and 6.2.4 above, in essence there is a continuum of control to drift which makes these distinctions very subtle, depending on the interpretations of the researcher and the context where these factors are encountered. As such, the diagram below presents those factors based on the findings from the case study companies examined, and the interpretation by the researcher according to the particular context of those companies.

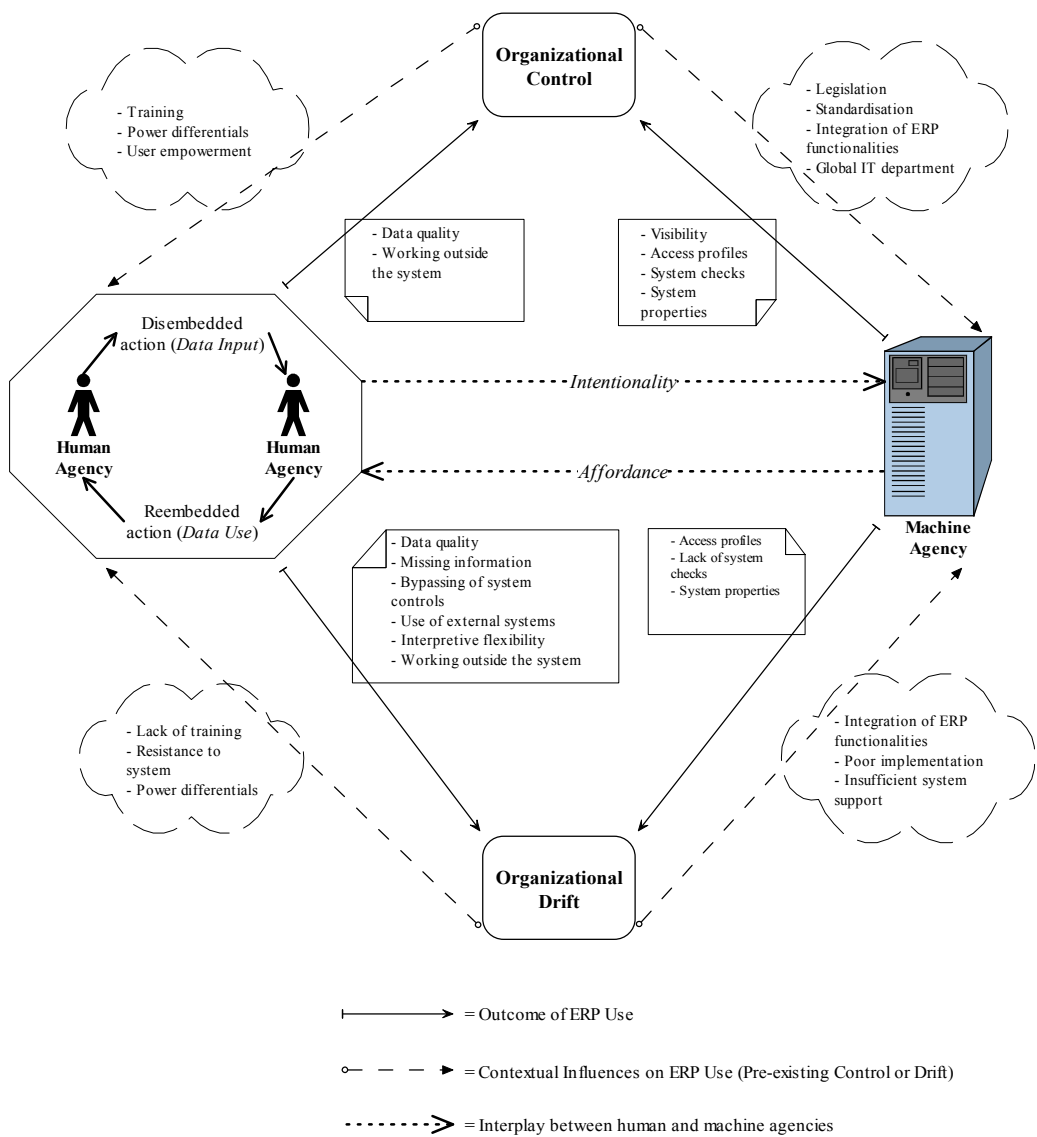


Figure 17: Conceptualisation of ERP use, control and drift

With regards to this context, and although not shown in the diagram above, the *culture* of the firm is also implied to play a big role on the use of the ERP system and the relevant organizational consequences (control and/or drift). The cultural factor is not shown in the diagram above, as it does not relate to any particular element of the diagram directly, but rather has an overall influence on the overall use of the ERP system. Despite the inherent difficulty in defining the concept of culture (as has been discussed in section 2.8.6.4), culture does indeed have a big role to play with regards to the use of the ERP system and the organizational consequences. Culture was observed mostly in the main case study of this research, Alstom. In this case many cultural characteristics such as giving priority to fixing trains instead of maintaining accurate records of work carried out in the ERP system, as well as the culture of sharing computer accounts and not inputting hours worked on a job, had a direct impact on the way the ERP system was used, which was seen to be suboptimal.

As has been mentioned in section 2.8.6 as well, there can be many definitions and interpretations of the concepts of empowerment, resistance and power differentials which are shown in the diagram above as contextual factors impacting ERP use. The particular interpretation given by the researcher in this case was influenced by the views of the respondents and the observed context in the companies where those concepts were encountered.

Empowerment in this case was interpreted by the interviewees at Reuters to mean to give more tasks to employees to carry out in the system, in order to relieve managers of unnecessary work (corresponding to Clement's (1994) "functional empowerment"). The alternative view of empowerment at NTL however was to emancipate individuals (corresponding to Clement's (1994) "democratic empowerment"), which was mentioned not to be able to happen with the use of an ERP system. Empowerment in the different companies examined as a contextual factor impacting ERP use is also discussed in section 6.3.1 below.

With regards to resistance, this was observed mostly in Alstom as the main case study of the research, and although some authors claim that resistance can be seen as an alert with potential problems (technical and/or business) with the system (Kavanagh, 2004; Marakas and Hornik, 1996), resistance in this case was interpreted to have a drifting effect on the use of the ERP system, more in concordance with the views of authors viewing resistance as detrimental to a company's operations (e.g. Kossek et al., 1994; Martinko et al., 1996).

Finally, power differentials are shown in the diagram above as being both a drifting *and* a controlling contextual factor impacting the use of the ERP system. Despite the inherent difficulties in defining power and the many interpretations of it (described in section 2.8.6.1), power in this thesis referred to the relational notion of power (Giddens, 1984), and also to the Foucauldian conceptualisation of power/knowledge (Foucault, 1980). Managerial power over the way users used the

system in Chubb Fire was seen to increase control in this case over the use of the system. On the other hand, increase of knowledge of the ERP system by users in Alstom participating in the implementation phase was seen to affect negatively the envisaged centrality of control over the use of the system, as these users were perceived as ERP “experts” by other users who bypassed the central helpdesk when problems with the system arose.

Based on the examination of the case study companies and the above described themes, the next section discusses how the research questions of this thesis were addressed.

6.3. *Revisit of Research Questions*

The research questions that were presented in section 1.4 and elaborated in section 4.7 of this document are summarized below:

1. What are the key contextual factors (in the form of pre-existing control and drift) that influence the role and use of an ERP system?
2. How does the actual use of an ERP system influence organizational control and drift?

The first research question is discussed in section 6.3.1 below, by comparing in each of the five companies examined the contextual factors (in the form of pre-existing control and drift) that resulted in different roles of the ERP system. This is also in response to the call by Wagner et al. (2005) for a better understanding of the unique context where IT is used.

The second research question is discussed in section 6.3.2 below, by examining the factors of ERP use leading to organizational control or drift. As in Alstom a large number of users were interviewed regarding their use of the ERP system, mostly the results from Alstom are discussed.

The discussion centred on the two research questions of this study then also addresses the knowledge gap discussed in section 2.7, where the lack of studies relating to the way organizational control and drift impacts, and is impacted by the use of the ERP system was identified.

6.3.1. Impact of contextual factors on ERP role and use

The common theme amongst all of the companies examined was that the role of the ERP system was seen mostly as facilitative rather than strategic. In that sense, the ERP system was installed to facilitate the companies' operations, and standardise their data and processes, as much as that was feasible. On the other hand, the companies examined did not mention that the ERP system would give them any strategic advantage over their competitors, but that they had to have it installed to keep in pace with them. However, the centrality of the IT function was mentioned to be important in the companies of Reuters (with four service centres) and Alstom (with ITC in Paris), in order to be able to better control the use of the system across the locations where it was installed. Control of compliance to legislation (such as SOX) was also mentioned to be an important impetus in using the ERP system in Chubb Fire and Reuters.

With regards to the usefulness of the ERP system, the most sceptical of the companies examined was NTL. The managers interviewed there had a strong view that the ERP systems installed (Oracle and to a lesser extend PeopleSoft) were not very conducive to their operations, but that they needed to have those systems, mainly in order to better control their financial processes, the lackadaisical management of which led to the company facing financial difficulties in the past.

The interviewees at NTL also complained that ERP systems in general, and Oracle in particular, were not good at planning. The same people however also mentioned that they had very poor training, and were not aware of what the ERP system could actually do. However, the responses from interviewees at Chubb Fire and Alstom indicated that they *were* using the planning functionality of their ERP system (SAP in both cases). Although NTL was using Oracle and not SAP, their scepticism of ERP functionalities in general could be attributed to their mentioned lack of training and knowledge about those systems. This resulted in drift from using the systems they had to their full capabilities.

The role that the ERP system played in a company was also a result of the circumstances that the company faced with regards to its position in the market and way of operating. For example, although Reuters did have some problems with their ERP system (Oracle) which they were gradually overcoming, they did manage to accomplish the installation of a single instance of the ERP system across all of their locations around the globe. NTL on the other hand was struggling with using the single instance they had installed locally at their offices in Hook.

Reuters and NTL however, although both had Oracle Financials installed, came from very different backgrounds. Reuters was a very homogeneous company regarding its operations around the world, in the way that it was handling the financial information that it was selling to financial institutions. NTL on the other hand had been expanding continuously over the last years, engaging in mergers, sell-offs and acquisitions. It would therefore be very difficult to install an ERP system that would cover the operations of all the different companies they bought. This meant that although Reuters wanted as much control and integration of their operations as possible by the installation of the ERP system, NTL purposefully did not want to fully integrate its operations via the ERP, in order to be able to more easily expand in the future. NTL was therefore trying to find the right balance between control and drift in order to remain resilient (Ignatiadis and Nandhakumar, 2007b) to existing and future business requirements. Consequently, the degree of integration of the company's processes through the ERP system was a determining factor on the degree of control and drift that was impacting on the use of the system. More integration of business processes through the ERP system then generally meant better control over these processes, whereas less integration meant less control and more potential drift. However, this drift in the case of NTL was intentional, to match its business necessities of expanding in the future.

The difference in operations in different company locations around the globe was also a problem for Alstom, who had different version of SAP in many locations, often not communicating with each other. Some of the interviewees in Alstom mentioned that they were not happy with the consulting company who carried out the implementation, and many of them complained about lack of training and ease of use of the system. In Reuters on the other hand, training was not mentioned to be a problem, and the self-service HR capabilities were seen as empowering users to better control their own HR records.

Reuters however was only using the Financials and HR modules of Oracle, which could be more easily standardised across its various locations worldwide. Reuters was not using any manufacturing or warehouse operations, which was the case with Alstom. As such operations differed considerably in Alstom amongst its various locations, the company consequently had many difficulties in integrating them through the ERP system, which led to the writing of ad-hoc interfaces in many cases (e.g. between PartsLink at Preston and other depots, with the “Genesis” project).

Chubb Fire and Multiyork on the other hand both had manufacturing and warehousing operations supported by their ERP system (SAP), but they did not have many complaints of those operations, in contrast to Alstom. Although Chubb Fire had a quite stable system working, Multiyork was still in the process of implementing it. Both of those companies however recognized the importance of training in order to gain benefits from the ERP system and better control its use. In Alstom however, the priority was to get the trains fixed as quickly as possible, but the ERP system was not seen as being conducive to this. Consequently, training was given only to a few key individuals working with the system, and generally training was seen by most of the interviewees as lacking. Lack of training therefore was a major source of drift in Alstom with regards to using the system efficiently.

In addition, power differentials played different roles in different companies with regards to the use of the ERP system. In Chubb Fire for example, the creation of “operational champions” within each business unit was meant to increase control over the way the system was used by its users. In order to achieve this, certain individuals (managers) were trained extensively on the use of the system in their area, and were also aware of their business requirements. By doing so, these managers were given the power to guide users on how to use the system according to those business requirements.

In Alstom on the other hand, some users were given implicit, unauthorised power, by gaining more knowledge of the ERP system than other users. Users that participated in the design and implementation of the system were perceived as ERP experts, although they were working in a particular functional area of the system and not as internal ERP consultants. Those users were then given the power by other users to help them with the problems they had on the system. This informal

assignment of power however meant that the envisaged centrality of control over the way the ERP system should be used was bypassed, as users did not log their problems with the helpdesk. As such, training and system configuration requirements from the part of the users could not be obtained. The company therefore drifted with regards to the degree of control that it envisaged of having over the ERP system.

The companies also had different views regarding the degree to which ERP systems were empowering their users. Multiyork was quite optimistic that after the full installation of SAP, users would be empowered to carry out transactions in the system directly themselves. Chubb Fire from its many years of ERP use recognized that users could be empowered to handle transactions in the system which also involved financial data, but that limits would have to be set up in the system, and the manager would need to be aware of employee actions in the system. This form of empowerment mentioned by Multiyork and Chubb Fire can be linked to Clement's (1994) "functional empowerment" (see section 2.8.6.2), carried out in order to relieve managers of unnecessary work. The mention of the interviewee at Chubb Fire that with empowerment greater controls in the system would also have to be implemented, also agrees with the literature on the required balance between empowerment and control (Simons, 1995a, 1995b).

Reuters was the most positive amongst the companies examined with regards to the empowerment of users using the HR capabilities of Oracle. This was because users were allowed to maintain and control their own personal records and data in the system, which relieved managers from doing it themselves. As this form of empowerment mentioned at Reuters was seen to benefit both users and managers, it can be classified as both "functional" and "democratic" empowerment (Clement, 1994). Alstom however, as it had many problems with the standardisation of processes and training, did not see any empowerment from the use of the system at all.

The most negative view with regards to empowerment from the system however, was the one held by NTL. The interviewees there saw ERP systems as being rigid financial control mechanisms, which removed any source of empowerment from users. The role of the ERP in this case was seen to be the establishment of financial controls that users had to adhere to, in essence removing from them any sort of decision-making capabilities. In that sense, NTL were mentioning that "democratic" empowerment (Clement, 1994) from the use of the ERP system cannot take place at all.

In summary, contextual factors in the form of organizational control impacting on the role and use of the ERP system were seen to be the need to adhere to legislation, the standardisation of processes through the ERP system, a global IT department responsible for the use of the ERP, as well as the empowerment of users in handling their own data in the system. Drift on the other hand in the form

of a poor implementation would definitely impact on the use of the system by end users, as users would not be able to gain the full benefit of its use. The level of integration of ERP functionalities, the adequacy and efficiency of training, as well as the power differentials created by the introduction of the ERP system could then be interpreted as either control or drift impacting on the use of the ERP system, depending on the particular organizational context and business necessities of the companies concerned. The contextual factors impacting ERP use are shown in Figure 17 above, where the results from all the companies examined are presented.

Having described the contextual factors (in the form of organizational control and drift) that could impact on the role and use of the ERP system, the next section in turn describes the impact of the actual use of the ERP system on organizational control and drift. This addresses the second research question of this thesis.

6.3.2. Impact of ERP use on organizational control and drift

When it came to the actual use of the system, from the limited amount of data collected from Multiyork, Chubb Fire and NTL, control of employee actions through the ERP system was seen to be facilitated by the visibility of user actions, the setting of access profiles (including authorisation levels for the handling of financial data), and various system checks for data and process accuracy carried out by the system. The examination of Reuters confirmed the findings of the previous three companies with regards to control through the use of the ERP system, and also added organizational control by working outside the system, but using data from the system (e.g. for manually authorising outgoing payments).

On the other hand, a common source of drift that was seen in all of the companies examined was the use of systems external to the ERP. The most common example was the use of Excel to produce reports of adequate quality, which the ERP system could not cope with. In addition, other types of reporting software such as Crystal Reports, which was using data from the ERP system, were used in Alstom. By using external systems as such however, the data could then be manipulated intentionally or unintentionally, as they fell under different, or no access restrictions.

Other sources of drift included the inaccuracy or lack of data in the system, which could be a result of incomplete training, therefore the users not understanding the system and resisting it, or the users having an incomplete understanding of the impact of their actions in the system to other users. Sources of drift also included workarounds devised by the users in the system in order to accomplish their tasks, effectively bypassing the intended controls in the system. The system not carrying out important checks for data accuracy, and users using their interpretive flexibility (Cadili and Whitley, 2005; Orlikowski, 1992) in inputting data (e.g. using text

fields instead of functional fields) was also interpreted as contributing to organizational drift.

Although ERP use was not directly observed in the companies of Multiyork, Chubb Fire, NTL and Reuters as mostly managers were interviewed with a small number of interviews, this was much more apparent in the case of Alstom, due to the larger amount of time spent at the company, and the larger number of users that were interviewed. The pressing need of the company in this case was repairing trains and putting them back on circulation as soon as possible. The use of its ERP system (SAP) was considered secondary in this process, as the company would be losing money with some types of contracts if the trains were not repaired on time.

The inattention that was paid to the correct use of SAP was evident in the lack of training of which most users were complaining about. This lack of training led in many cases to users not using the system to its full use, or using it erroneously. The lack of inputting information or the quality of information in the system consequently suffered as a result. For example, users did not see the importance of inputting customer details in the system when setting up contracts, with the result that work that was done on customer trains could not be charged for. Or in other cases the information was captured in the wrong fields, for example recording hours worked in a descriptive text field instead of the corresponding numerical field in SAP. All of these factors led to drift from the ideal of efficiently controlling the company's data.

Alstom was also bound by external requirements from customers regarding the use of systems other than SAP. For example, some customers of Alstom required that any details about train faults and repairs were entered into Ravers, a rail industry standard system for the recording of such defects. Alstom was obliged to enter those details into Ravers, and also entered them into SAP for its own record-keeping, resulting in double data entry. However, many times the details were only entered into Ravers, as users were much fonder of it than SAP, due to its simplicity and ease of use. However, this still resulted in drift due to SAP not being up-to-date with information on train faults and repairs.

Another factor impacting the use of SAP in Alstom was the culture of trusting other users to use one's login, which existed at the workshops where trains were being repaired in the Manchester depot. Users there knew each other and were working together most of the time in one small shed near the area where trains were being repaired. There was no supervisor in those premises, as he was located in the main building outside the workshop areas. Users had one PC with SAP installed at that shed, and each user was given his own login to log into the system. However, what was happening was that the first person that came in the morning logged into SAP, and the last who left logged off. In the meantime, all the users were using the login of the person who was logged on in the system, in order not to lose time logging that person out and logging themselves in. This in essence meant

that the controls of SAP implemented via access profiles were bypassed, resulting in drift from the envisaged access controls in the system.

In Alstom there was also a culture of trusting others to use the system outside their immediate functional area, and this was evident in the setting of access profiles in the system. Some people were given more access than they required, in case one of their colleagues was off sick or not available, so that another person would be available to carry out their transactions in their absence. However, this meant that users with increased access sometimes abused this, by carrying out transactions that they should not be doing, such as transferring stock to sites other than their own.

In summary, use of the ERP system was interpreted to result in organizational control from the visibility of user actions afforded by the system. Organizational drift was interpreted to result by users trying to bypass the established controls in the system, using systems outside the ERP where data could be more easily (intentionally or unintentionally) manipulated, as well as users exercising their interpretive flexibility when using the system. Certain system properties and checks carried out, the access profiles in the ERP system, the quality of the data input by users, as well as the process of working outside the system could then result in organizational control or drift, depending on the particular context of ERP use. These factors impacting organizational control and drift from the use of the ERP system are summarized in Figure 17 (in section 6.2.5), where the results from all the companies examined are presented.

Having described how contextual factors (categorized as pre-existing organizational control and drift) impacted on the role and use of the ERP system in the particular context of the companies examined (in section 6.3.1), as well the consequent impact of ERP use in the companies examined on organizational control and drift (in the current section 6.3.2), the next section discusses the contributions of this research for theory.

6.4. Contributions

The results from this thesis have contributed to an increased understanding of the way that ERP use is influenced by contextual factors, and influences organizational control and drift. As there is only a small number of studies dealing with the actual use of an ERP system and its consequences (according to the knowledge gap identified in section 2.7), it was considered important to examine the actual use of an ERP system and its impact on an organization. In addition, as there is an even smaller number of studies in the literature dealing with control from ERP use, and the number of studies dealing with drift from ERP use is actually non-existent, this study has tried to address the way that control is re-enacted, and drift is propagated with the use of an ERP system. By doing so however, it was also necessary to examine the contextual factors that existed either prior to ERP use (such as the implementation history of the ERP, internal organizational and external mandates such as legislation), or that impacted ERP use throughout (such as the degree of integration of the system, training, and power differentials regarding the use of the system). These contextual factors were interpreted and categorized as pre-existing organizational control and drift impacting the use of the ERP system.

The actual contributions of this thesis include contributions for theory, as well as contributions for practice. The contributions for theory include the development of conceptualisations to aid in future studies of IT use, as well as the demonstration of the importance of theoretical concepts (such as embedding/disembedding, human/machine agency) in such studies. The contributions for practice then include lessons learned from the examination of the case study companies, in order to aid managers pay better attention to the use by the company users of the ERP system, and maximize the associated organizational benefits.

6.4.1. Contributions for Theory

In order to examine the contributions of this thesis for theory, the next section compares its findings with existing relevant literature dealing with the themes of ERP systems, human and machine agencies, and control and drift.

6.4.1.1 ERPs, human and machine agencies, control and drift

Although Kallinikos (2004) seems to imply a strong influence of the machine agency of ERP systems in delineating paths of human action, the findings from this study indicate that human agency can also influence the way the system operates, by the interplay between human and machine agencies. In that sense, the results of

this study are more in accordance with the findings of Orlikowski (2000), who argues that users can do circumvent intended uses of technology, even in the case of ERP systems, which are seen as inflexible software packages (Boudreau and Robey, 2005). The circumvention of intended uses (through the bypassing of controls and users' interpretive flexibility) has been linked to organizational drift in the current study.

The conceptualisations carried out in this research are in compliance with the claims by Dechow and Mouritsen (2005), who acknowledge the interplay between human and machine agencies in ERP use, by arguing that "there is an interplay between ERP systems telling people what to do and people telling the ERP system what to do. They are both constraints and enablers and neither offers an open set of possible actions" (p. 730). The results from this study further refine their concepts, by arguing that such an interplay can result in organizational control if the properties of the ERP system meet the company's objectives and human agents (users) accept the system and use it accordingly, without trying to bypass it. On the other hand, if either the capabilities of the system cannot meet the company's needs, or users (intentionally or unintentionally) resist the system or try to bypass it, then organizational drift can occur.

The findings of this thesis are also in compliance with those by Dillard et al. (2005), in the sense that ERPs can better control actions and behaviours of users. This was shown in this thesis to be accomplished with access profiles and authorisation levels, visibility of user actions, as well as system checks for data accuracy. However, the findings of this study also partially contradict Dillard et al. (2005), who argue that as user actions in the ERP system are inherently recorded, tracked and analyzed, individual autonomy is lost and users are dehumanized. To argue so, Dillard et al. imply the supremacy of the machine agency of the ERP system, leaving no part for the human agency. However, as this research has shown, human agency can have a big role to play in ERP use, either through resistance of the system, bypassing the system controls, interpretive flexibility, or by users being empowered to use the system for their own advantage (e.g. maintenance of HR records and expenses in Reuters). Whether the machine or the human agency appears stronger however, is a combination of many factors, including the properties of the actual ERP system, the way the system was configured (e.g. for the setting of access profiles), and the sophistication and perception of users with regards to the functionality of the ERP system and their compliance to it.

The findings of this study also partially contradict those by Hanseth et al. (2001) who seem to imply that ERP systems can simply make firms drift. As has been argued in this thesis, drifting is a condition of the interplay between human and machine agencies. When drift does occur however, the findings of this thesis complement those by Hanseth et al., who claim that side effects can lead to loss of control due to the integrative nature of an ERP system, through which these side

effects are “rippled”. The results of this thesis enhance this understanding by arguing that drift can occur through the disembedding and reembedding of user actions in the system, according to the affordances of the ERP system. It is then through the disembedding and reembedding of user actions according to the capabilities of the system, that these side affects are “rippled”, by affecting other users and areas of the system.

Part of the theoretical contributions of this research is also the conceptualization developed to account for ERP use and its consequences in an organization. This conceptualization can also be used in studies of IT use in general, as is discussed in the section below.

6.4.1.2 Template for examination of IT use and consequences

From a theoretical perspective, this thesis has presented a conceptualisation to account for the use of an ERP system according to contextual factors, as well as accounting for the consequences of ERP use in terms of organizational control and drift. As such a conceptualisation seems to be missing from the literature, it can serve as a starting point for the examination of issues with the use of an ERP system.

The conceptualisation developed however, can also be generalised to the examination of the use of other IT systems, and their impact on organizational control and drift. A template to illustrate the important elements in the examination of the use of IT systems and their consequences in this case is shown in Figure 18 below.

The conceptualisation points in particular to the examination of human and machine agencies in the use of an IT system. This then means that both the capabilities (affordances) of the IT system must be examined, as well as the way users use the system, and their intentions in doing so. The way that actions of one user affect the actions of another user (through the disembedding and reembedding of information in the system) must also be taken into consideration when examining IT use and its consequences. The more integrative the IT system then is (according to its coverage of functional and geographical locations), the more accentuated the impact of disembedded and reembedded user actions in the system. Therefore the conceptualisation of system use according to the disembedding and reembedding of user actions would be particularly suitable to other enterprise-wide systems such as CRM and SCM, B2B, etc.

The conceptualisation also points to the importance of contextual factors in determining IT use. Such contextual factors can be internal or external, and can relate to the organization itself and its culture, the characteristics of the industry in

which the company operates, governmental mandates, or other factors that may have an influence on the use of the IT system.

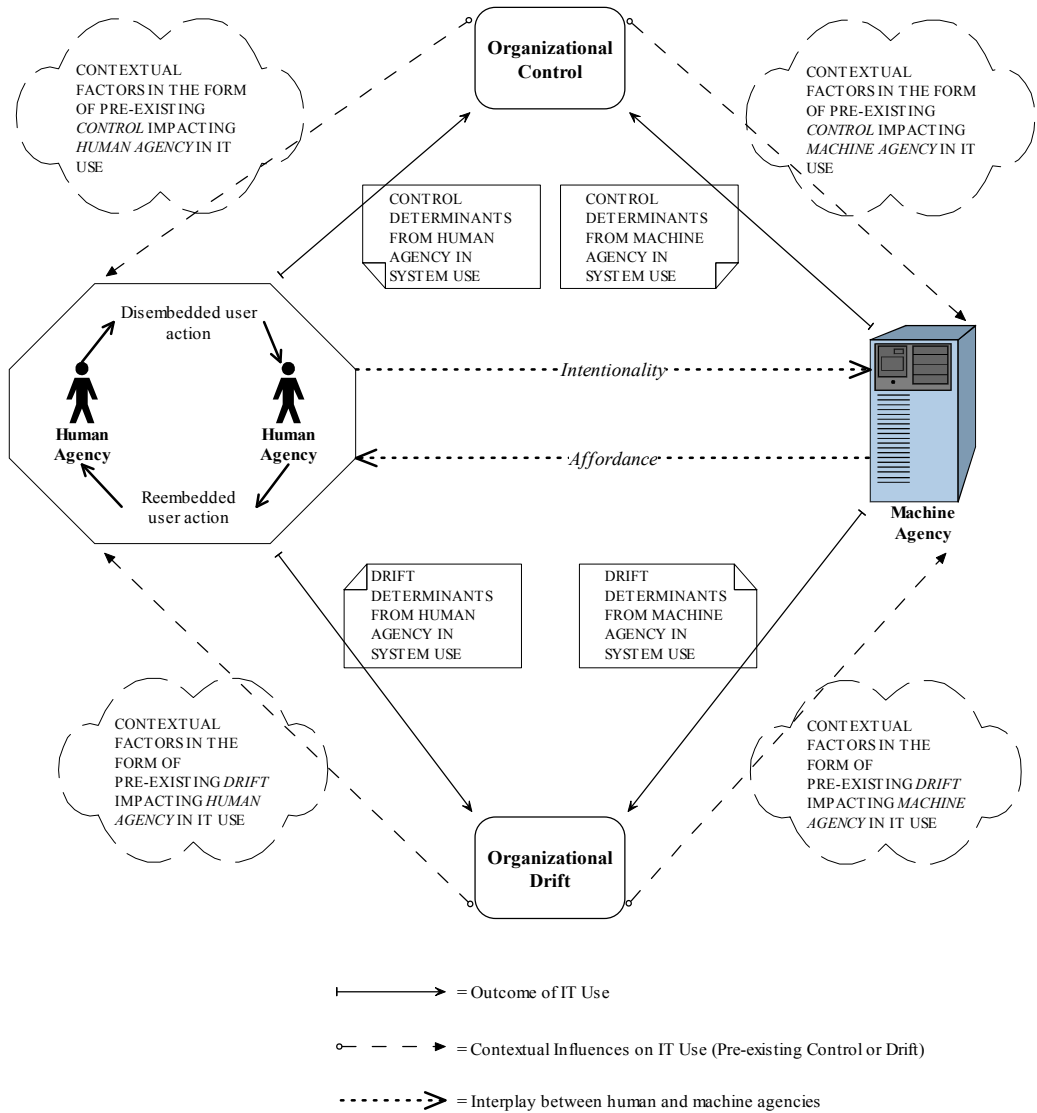


Figure 18: Template for examination of IT use and consequences

From the actual use of the system according to those contextual factors, as well as the capabilities of the system and the way users use it, the consequences from its use can then be examined. In the conceptualisation template above those consequences have been distinguished as control and drift. Although this classification is not meant to denote a positive / negative separation of consequences respectively, the template presented above can also be used in this way. This would then mean that the consequences of IT use would relate to whether they do or they do not meet the company’s business requirements.

However, it must be kept in mind that the distinction between control and drift may be very subtle, and will depend on the interpretation of the researcher and the research subjects, as well as the context where the use of IT is observed. Although the template below shows a demarcation of organizational control and drift, in essence the two concepts may be tightly interrelated and form a continuum. As such, it is then up to the perception and interpretative skills of the researcher to make the fine distinction, also taking into consideration the actual context where IT is used.

The next section describes in more detail the importance of the theoretical concepts employed in this research for future use in other contexts.

6.4.1.3 Importance of theoretical concepts

Although in studies of IS the concept of human agency (e.g. Boudreau and Robey, 2005; Kallinikos, 2004; Orlikowski, 2000) as well as machine agency (e.g. Askenas and Westelius, 2000; Dillard et al., 2005; Rose and Truex, 2000) and the interplay between the two (e.g. Ignatiadis and Nandhakumar, 2006b, 2007a; Rose and Jones, 2005; Rose et al., 2003) have been examined in the literature, the contributions of this thesis are in providing a comparatively large scale demonstration of the applicability of these concepts in studies of IS. This then means that other studies examining the interaction between humans and the IT artefact using these concepts can enhance our understanding of the nature of the relationship between human action and machine affordance and the organizational consequences of this interaction.

In addition, Giddens's (1990) concepts of disembedding and reembedding have been applied to a micro level in this thesis, concerning ERP use. These concepts have only been used in a very limited fashion to describe accounting systems such as Activity-Based Costing (Jones and Dugdale, 2002) or accounting systems in supply-chain relationships (Seal et al., 2004). In the IT area, Hanseth et al. (2001) have viewed an ERP system as a disembedding mechanism it itself. Although these studies focus more on the embedding and disembedding of whole systems, the results of this study have shown that these concepts can be equally used at the more micro-level, in particular with reference to the disembedding and reembedding of user actions in an ERP system. These actions are afforded by an ERP system that is globally deployed, has a single database, and a workflow definition of activities. As such, future research can use the concepts of embedding/disembedding in studies of similar types of enterprise-wide systems such as Computer-Supported Cooperative Working or Supply-Chain Management systems. The focus should then be on the interrelationship amongst actors using the system, and the way that actions of one actor impact other actors in the system.

Having described the contributions of this research for theory, the next section discusses its contributions for practice.

6.4.2. Contributions for Practice

From a practical perspective, the templates presented in Figure 17 and Figure 18 above can also be used to sensitize managers of companies regarding the use by their users of their ERP (or other IT) system. As such, the practical contributions described in this chapter are from a managerial perspective. The purpose is to help managers learn from the findings of the case study companies examined in this thesis, in order to find ways to increase the correct use of the system by its users, while also taking into consideration the capabilities of the system, the organizational needs of the company, and the context where the ERP system is being used.

From the lessons learnt from the examination of the case study companies, the importance of the quality of information entered in the ERP system must be stressed. As an ERP system integrates company activities and spans many departments, and because of the disembedding and reembedding of information in the system, errors or substandard information in the system can have a knock-on effect to other users and departments and the company as a whole (according to Hanseth et al., 2001, which was also observed in the case of Alstom with missing and erroneous information impacting other departments).

From a practical perspective, the use of the disembedding and reembedding concepts in the use of the ERP system actually points to the interdependencies of user actions in the system, and the way that actions of one user affect other users in the system. The results from Alstom indicate that the more integrated the system then is, the higher the impact of disembedded actions on other users of the system (see also Hanseth et al., 2001). The disembedding of information can consequently lead to control if the right information is disembedded, but can lead to drift if errors, omissions or data inaccuracies are disembedded as well. Although the examination of Alstom has indicated some instances of the interdependencies of user actions through the disembedding and reembedding of those actions, a more thorough analysis in a company that uses an ERP system would be facilitative in understanding these interdependencies.

By doing so, these interdependencies could also be communicated to users, in order for them to appreciate how their actions will affect other users in the system. The importance of training to be able to use the system accordingly is then also a major factor in the correct use of the system by its users. As was expected and the results from Alstom indicate, if training is lacking or is substandard, then this will have an impact on the actual use of the system. Training in this case is important in order

not only to understand how to use the system in one particular area, but also to appreciate the ways that user actions in the system depend on, and influence the actions of other users. The results from Alstom again indicate that if training is inadequate, then drift can occur by the users resisting, abusing, or misusing the system.

In addition, managers should be aware of the importance of correctly setting the access profiles for the users who are using the system, according to their needs. If users are given too much access to the system then they may use this to abuse the system. If they are given inadequate access, then they may not be able to carry out the functions needed for their job. The definition of the access profiles according to organizational and user needs can then help the company have better control over its data and operations, otherwise such control is lost and drift can occur, as the case from Alstom has indicated.

Apart from access profiles however, the company must be wary of how much control it wants to implement through its ERP system, and how much leeway it can accept, according to its organizational needs (Ignatiadis and Nandhakumar, 2007b). Too much control through the ERP system can serve to streamline the operations of the company, but at the same time can decrease the resilience of the company to respond to future challenges and adapt to new realities, as the case of NTL has shown. In that sense, some degree of calculated drift may be beneficial. This drift can be implemented by not fully integrating the ERP system in the company, but by using other systems at the same time as well.

Too little control on the other hand can cause excessive drift, which can be harmful to the company. Drift can also occur by a fully integrated system as has been mentioned however, as the risk of single errors in one area of the system “rippling” to other areas of the system multiply in this case (Hanseth et al., 2001). The thin line between control and drift is different for each company, and managers have to decide how much of each they can accept.

Either way however, the capabilities of the ERP system must be clearly understood and documented. Although training is quite important in this case, incomplete understanding of the system capabilities can result in its under-use and misconceptions about its functionality, as the case of NTL has demonstrated. In this regard a number of documents detailing each area of the system, explaining the various fields and their meanings, and the processing that could be done in each part of the system would be beneficial. Although such documentation was produced in Alstom, in the end it was also not used, as users could not see the benefit of those documents. It is therefore also important to emphasize the connection with business needs in such documentation, as well as the impact to other areas and users of the system.

From an organizational point of view, the results from this study indicate that the more integrative the ERP system is in a company, the more the need for the existence of a global IT department to oversee the functioning of the ERP system. In Reuters for example, as the system spanned all the countries where Reuters operated, the need for the establishment of four global service centres was recognized. Alstom also recognized this as the installation of SAP globally was proceeding, and allocated the global responsibility for its ERP system centrally to its IT department in Paris. NTL on the other hand, as the installation of Oracle was only local, was happy with the local maintenance of its ERP system. The actual use of the system may then also be influenced by external requirements such as legislation, as the need for adherence to SOX mandates at Chubb Fire and Reuters has demonstrated.

The results of this thesis also point to the fact that various other contextual factors impacting on the use of the ERP system should be taken into consideration. The nature of business for example that a company is in plays a big role in the way the ERP system is used. Companies in high-moving sectors that engage in continuous structural changes may find it difficult to install and use a fully-integrative ERP system, as the case of NTL demonstrated. Companies with more stable business such as Reuters on the other hand, may find better uses for a fully integrative ERP system.

The results from this thesis also indicate that appropriate attention should be paid to the (intentional and unintentional) power differentials generated by the installation and use of the ERP system. Careful allocation of power to some individuals (managers) in the company in order to oversee the activities of users in the system can be beneficial in this case. Such individuals must be well-versed in the workings of the system, as well as possessing an acute business perspective in order to be able to direct the use of the system to match the company's business requirements, as the case of the creation of "operational champions" in Chubb Fire has indicated.

On the other hand, informal and unintentional allocation of power to some users in the system can result in the company losing control over how the system is used by its users. As the example of Alstom has indicated, some users that gain a wide knowledge of the ERP system by participating in its implementation can consequently be perceived as ERP "experts" in the company by other users, in essence those "experts" being empowered by other users to help them with their problems in the system. If those arrangements are informal and tacit however, the company in the end loses control over the way the ERP system is used by its users, and cannot account for their behaviour in the system. It is therefore important to correctly and explicitly allocate responsibilities with regards to the use and support of the ERP system.

Finally, the cultural factors which are unique to each company and which may impact the use of the ERP system must also be taken into consideration. In Alstom

for example, the importance of fixing trains as soon as possible meant that at many times inattention was paid to the correct use of the ERP system. Users at some of the workshops also trusted each other to use one person's login to the ERP system, which deviated from the company's intention of controlling individual actions in the system.

Having described the contributions of this research for theory and practice, the next section presents the limitations and future research related to this study, including the adequacy and relevance of the research methods and theoretical concepts of the current research.

6.5. *Limitations*

A limitation of this research is that only one main case study company (Alstom) has been examined in depth, in addition to a limited examination of four other auxiliary case study companies (Multiyork, Chubb Fire, NTL, Reuters). However, this approach enabled to obtain rich data from Alstom, while using the other four companies as a means to carry out some high-level comparisons.

Despite the small number of case studies of this research however, and in common with any interpretive research, the findings of this study are not generalizable in a statistical sense, but present informing insights on an organizational phenomenon. As such, the results are generalizable into theory (Lee and Baskerville, 2003; Walsham, 1995b; Yin, 2003). This means that the results of this research contribute towards an increased understanding of how an ERP system can increase or decrease control within an organizational context.

In interpretive studies such as the current one, the examination of power relations is an important one, and this has also been demonstrated in relevant studies of IT (e.g. Bloomfield and Coombs, 1992; Doolin, 1999; Knights and Willmott, 1984; Law, 1991; Markus, 1983; Saunders et al., 2000; Scamell and Saunders, 1982). As this study focused on the interaction of users with the ERP system, the power relations between different human organizational actors have only been touched at a high level in this thesis (e.g. with the “ERP champions” at Chubb Fire and the perceived “ERP experts” at Alstom). However, it would be useful in interpretive studies such as the current one to examine such power relations more in-depth, and their influence on the use of an ERP (or indeed other IT) system.

The concept of culture (presented in section 2.8.6.4) is also important in interpretive studies, which includes studies of the impact of IT on organizations (e.g. Coombs et al., 1992; Davison, 2002; Gallivan and Srite, 2005; Leidner and Kayworth, 2006). As the four companies of Multiyork, Chubb Fire, NTL and Reuters were examined only with a small number of interviews, the concept of culture was not observed there. However, culture was observed in more detail in Alstom (including the culture of fixing trains as soon as possible, trusting other users to use their computer accounts, as well as not being diligent with regards to registering hours worked). It can be argued however that a more systematic handling of culture would also be beneficial in understanding factors impacting ERP use.

As the interviews were carried out within a limited time span (from February to August 2005 in Alstom), it was not possible to examine the progress achieved regarding the use of the ERP system. It can be argued that a more longitudinal approach (Pettigrew, 1990) would reveal the historical context influencing the use of the ERP system and explaining its current status. Although interviewees were

asked about the process of implementation in many cases, it can be argued that by the researcher directly observing the implementation him/herself and then also the actual use of the ERP system over a period of years, richer results could be obtained, which would present a fuller picture on the ways that the ERP system is used within an organization.

In addition, this study has also elaborated a number of contextual factors influencing ERP use, as well as number of factors from the actual use of the ERP system influencing organizational control or drift. A limitation of this study however is that these factors have been examined mostly in isolation. It can be argued that the examination of the interrelationships between the different factors identified and their changes over time (Nandhakumar et al., 2005) would be beneficial in presenting a richer understanding on the factors influencing and being influenced by the use of an ERP system.

Finally, a further limitation of this study is that the vendor assumptions built into the ERP system have not been examined with regards to their impact on ERP use. The business assumptions that ERP vendors incorporate into their systems and the technological choices adopted by them have an influence on the way the system is used by the end users within an organization. Examining such vendor assumptions and their impact on the way company users use the system can be argued to also give rich insights with regards to why users use the system the way they do. This could then also be contrasted with personal beliefs and interpretations, as well as company norms and procedures, and the way those compare with the vendor-built assumptions into the ERP system and influence its use.

6.6. Future Research

In future research the limitations cited in the previous section can be addressed. This can also include the examination of the degree to which the findings presented in this thesis are applicable in similar or disparate organizational settings.

Future research may therefore include examining other ERP (or other enterprise-wide) systems, apart from SAP and Oracle which were examined in this research, or examining the use of ERP systems in other companies. For example, the examination of control and drift from the use of supply-chain management, customer-relationship management, or e-business systems, using the theoretical template presented in Figure 18, would increase our understanding of the consequences of control and drift from the use of such systems. Although the boundaries between those systems and an ERP start to blur, by examining such systems which include external actors as well, important insights could be obtained. Such studies would also overcome the limitation of this paper that only internal actors with regards to their use of the system have been examined.

In addition, although the findings of this study present rich insights with regards to ERP use and have been generalized into theoretical conceptualisations, the methodological limitation of using only semi-structured interviews can be overcome in future research. Although a positivistic study (e.g. by examining a large number of case studies) could identify in more detail and categorize in a more systematic manner the contextual factors impacting ERP use, and similarly for the aspects of ERP use that lead to either control or drift within an organization, this would not result in the rich insights offered by an interpretivist study. It would therefore be useful to examine the research questions of this study in another context in depth, and in a more systematic manner. This could include a more detailed analysis of the factors of ERP use impacting on or being impacted by organizational control and drift, as well as examining their interrelationships, which has not been examined in this research.

Future research would also have to look at the actual capabilities of the ERP system in more detail. This would overcome the limitation of this study which was not to provide a detailed and accurate list of the capabilities of a particular ERP system, but rather to provide rich insights and conceptualisations in order to enhance our understanding of the issues affecting and resulting from ERP use.

6.7. Concluding Remarks

The purpose of this thesis has been to present the findings of an interpretive case study research on the use of ERP systems and their organizational consequences. It was argued that the use of an ERP system depends on (internal and external) contextual factors, which have been classified as either pre-existing organizational control or drift. The actual use of the system then also depends on the relationship between the actions of users in the system and the affordances of the system, as well as the interactions amongst various users in the system. The outcome is organizational control or drift (which however could be seen as a continuum).

Conceptualisations to account for the use of an ERP system according to the findings of this research were also developed. These conceptualisations were sensitive to identified theoretical concepts such as human and machine agencies and embedding/disembedding, as well as relevant literature on control, drift and ERP systems in particular. The implications of this research for both theory and practice have also been elaborated.

More generally, the results of this thesis point to the importance of identifying contextual factors impacting the actual use of an IT system, as well as taking into consideration the capabilities of the system and the actions and interactions of users in the system. The importance and applicability of the concepts of human (user) and machine (system) agency in relevant studies of IT use were demonstrated by the particular application in the case of the use of ERP systems. The applicability of the concepts of embedding/disembedding in studies of enterprise-wide and distributed IT systems in particular (such as ERPs) was also demonstrated. The results of this research can then help sensitize future studies of IT use, which can take into consideration the developed conceptualisations in order to examine the organizational consequences of IT use.

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Appendix A – Interview Schedules

Multiyork

Table 28: Interview schedule at Multiyork

Interview Date	Position	Area	Interview Location	Interview Duration (Minutes)	Remarks
10/12/2004	IT Manager	IT	-	45	Telephone Interview
11/2/2005	IT Manager	IT	-	50	Telephone Interview
<i>Total Number of Interviews: 2</i> <i>Number of Interviewed Persons: 1</i> <i>Total Interviews Duration: 1 hours 35 minutes</i>					

Chubb Fire

Table 29: Interview schedule at Chubb Fire

Inter-view Date	Position	Area	Interview Location	Interview Duration (Minutes)	Remarks
5/10/2004	Purchasing Manager	Procurement	Coleshill, Birmingham	55	Face-to-face interview
14/3/2005	Purchasing Manager	Procurement	Coleshill, Birmingham	95	Face-to-face interview
<i>Total Number of Interviews: 2</i> <i>Number of Interviewed Persons: 1</i> <i>Total Interviews Duration: 2 hours 30 minutes</i>					

NTL

Table 30: Interview schedule at NTL

Interview Date	Position	Area	Interview Location	Interview Duration (Minutes)	Remarks
19/11/2004	- Supply Chain Manager 1 - Supply Chain Manager 2	Procurement	Hook	90	Joint face-to-face interview
28/2/2005	Supply Chain Manager 1	Procurement	Hook	90	Face-to-face interview
Total Number of Interviews: 2 Number of Interviewed Persons: 2 Total Interviews Duration: 3 hours					

Reuters

Table 31: Interview schedule at Reuters

Interview Date	Position	Area	Interview Location	Interview Duration (Minutes)	Remarks
18/1/2005	- General IS Manager - Business Centre IS Manager	IS Department	London	120	Joint face-to-face interview
16/2/2005	General IS Manager	IS Department	London	95	Face-to-face interview
9/5/2005	Accounts Payable Employee	Finance	London	55	Face-to-face interview with demonstration of system
9/5/2005	Cash Management and Treasury Process Director	Finance	London	80	Face-to-face interview
9/5/2005	Record to Report Process Director	Finance	London	50	Face-to-face interview
Total Number of Interviews: 5 Number of Interviewed Persons: 5 Total Interviews Duration: 6 hours 40 minutes					

Alstom

Table 32: Interview schedule at Alstom

Interview Date	Position	Area	Interview Location	Interview Duration (Minutes)	Remarks
9/2/2005	IT Manager	IT Management	Birmingham	20	Face-to-face, pilot interview
9/2/2005	Assistant Accountant	Finance	Birmingham	35	Face-to-face interview
9/2/2005	Materials Controller 1	Materials Management	Birmingham	60	Face-to-face interview
9/2/2005	SAP Facilitator 1	Service Management	Birmingham	60	Face-to-face interview
11/2/2005	IT Manager	IT Management	-	50	Telephone interview
23/2/2005	Accounting Reports Manager	Finance	Preston	50	Face-to-face interview
23/2/2005	Purchasing Manager	Purchasing	Preston	55	Face-to-face interview
23/2/2005	Flow Repairable Controller	Service Management	Preston	40	Face-to-face interview
23/2/2005	Business Improvement Coordinator	Warehouse and Distribution	Preston	40	Face-to-face interview
23/2/2005	Logistics Director	Warehouse and Distribution	Preston	50	Face-to-face interview
23/2/2005	- Inventory Planner 1 - Inventory Planner 2	Warehouse and Distribution	Preston	55	Joint face-to-face interview
16/3/2005	Assistant Finance Manager	Finance	London (Wembley)	45	Face-to-face interview
16/3/2005	Accounts Payable Clerk	Finance	London (Wembley)	55	Face-to-face interview
16/3/2005	Commercial Assistant	Sales	London (Wembley)	50	Face-to-face interview
16/3/2005	Shift Planning Coordinator	Service Management	London (Wembley)	55	Face-to-face interview
16/3/2005	Shift Planner	Service Management	London (Wembley)	65	Face-to-face interview
17/3/2005	Assistant Accountant	Finance	Birmingham	45	Face-to-face interview
17/3/2005	Materials Controller 1	Materials Management	Birmingham	65	Face-to-face interview
17/3/2005	SAP Facilitator 1	Service Management	Birmingham	65	Face-to-face interview
17/3/2005	IT Manager	IT Management	Birmingham	30	Face-to-face interview

Interview Date	Position	Area	Interview Location	Interview Duration (Minutes)	Remarks
17/3/2005	Business Process and Global Information Systems Director	IT Management	Birmingham	25	Face-to-face interview
8/4/2005	SAP Facilitator 2	Service Management	Manchester	80	Face-to-face interview with demonstration of system
8/4/2005	Materials Planner	Materials Management	Manchester	45	Face-to-face interview with demonstration of system
8/4/2005	Materials Controller 2	Materials Management	Manchester	20	Face-to-face interview
8/4/2005	Billing Clerk	Finance	Manchester	40	Face-to-face interview with demonstration of system
8/4/2005	Production Planner	Service Management	Manchester	75	Face-to-face interview with demonstration of system
8/4/2005	Sales Facilitator	Sales	Manchester	35	Face-to-face interview
8/4/2005	Head of Production	Service Management	Manchester	50	Face-to-face interview with demonstration of system
8/4/2005	Maintenance Policy Leader	Service Management	Manchester	40	Face-to-face interview with demonstration of system
22/8/2005	Materials Planner	Materials Management	Manchester	65	Face-to-face interview with demonstration of system
22/8/2005	SAP Facilitator 2	Service Management	Manchester	115	Face-to-face interview with demonstration of system
22/8/2005	Reliability Group Leader	Service Management	Manchester	65	Face-to-face interview
22/8/2005	Sales Facilitator	Sales	Manchester	35	Face-to-face interview
22/8/2005	Abnormal Work Manager	Service Management	Manchester	55	Face-to-face interview
23/8/2005	Production Planner	Service Management	-	40	Telephone interview

Interview Date	Position	Area	Interview Location	Interview Duration (Minutes)	Remarks
24/8/2005	Materials Controller 2	Materials Management	-	35	Telephone interview
<i>Total Number of Interviews: 36</i>					
<i>Number of Interviewed Persons: 27</i>					
<i>Total Interviews Duration: 30 hours 10 minutes</i>					

Appendix B – Interview Guidance Notes

General Introduction to Company

- Company introduction, history
- Size of department, organizational structure, activities performed, responsibilities, customers
- Technology knowledge
- Internal organizational and external company controls
- Empowerment in the company

ERP Implementation History

- History of ERP implementation, reason for implementation, organizational requirements, organizational changes from ERP implementation, problems encountered, solutions adopted
- Role of external consultants, IT department, internal users
- Training
- Resistance to system
- Role of ERP, importance

ERP Use

- Work carried out in the system, problems encountered, main complaints, ways of solving problems
- Relationship with IT department, ERP consultants, vendor
- Monitoring of employees' work in the system
- Dependency on / interrelationship with the work of other users
- Decision-making capabilities of employees in the system
- Risks taken by use of the system

- Workarounds in the system
- ERP system-based controls
- Perceived failure of controls
- Quality of work measurements
- Comparison with work prior to ERP system
- System input, system output, use and interrelationships
- Overall perception of the system by its users
- Use of other systems complementary/instead of ERP

Appendix C – Tactics for Conclusion Drawing / Verification

The table below describes the tactics for drawing and verifying conclusions (Miles and Huberman, 1994) in a qualitative study, and the relation of those tactics to the current research, as has been discussed in section 3.7.3. The list in the table below is arranged roughly from the descriptive to the explanatory, and from the concrete to the more conceptual and abstract.

Table 33: Tactics for drawing and verifying conclusions and relation to current research

Tactic	Description	Relation to current research
Noting patterns and themes	This refers mainly to pattern coding, where one notices recurring patterns of themes when one is working with text or less organized displays.	Noting patterns and themes was done in the first pass of coding, by examining common threads amongst the interviewees' responses. Those were coded according to the coding schema shown in Figure 6.
Seeing plausibility	This refers to the case when a conclusion "makes good sense", or "fits", "feels right", seems plausible, but without being able to explain why.	Seeing plausibility was done intuitively with the arrangement of data under different categories in the first pass of coding, and trying to see how the data refuted or corroborated various theoretical concepts, in order to arrive at the ones shown in section 2.8.
Clustering	This refers to (inductively) grouping into categories and then conceptualizing objects that have similar patterns or characteristics.	Clustering was done both in the first pass of coding, as well as in the second pass of coding; in the latter case the clusters referring to variables such as control, drift, human agency, machine agency, embedding, disembedding.
Making metaphors	This involves comparing two things via their similarities and ignoring their differences. Like the three preceding tactics, this helps achieve more integration among diverse data.	Metaphors were used by abstracting ERP use to categories such as embedding / disembedding, which helped link raw interview data to the identified conceptual categories.
Counting	This helps to isolate something that is happening a number of times, and consistently in a specific way.	Counting was not done intensely as a method of drawing conclusions, but rather at a very high level, e.g. according to the matrices shown in section 3.7.2 (Data displays).
Making contrasts/ comparisons	This involves comparing or contrasting two things, be they persons, activities, whole cases, etc. Comparisons aim to find how X differs from Y, when X and Y are known to differ in some ways.	Making comparisons was carried out in the current research by examining different responses of interviewees (e.g. their views on the ERP system) in one company (mainly Alstom), as well as contrasting the contextual factors that determined ERP role and use across the companies examined.

Tactic	Description	Relation to current research
Partitioning variables	This refers to the case when one variable is not really unique, but can be split into two or more variables.	Partitioning of variables was not carried out in the current research, but rather the approach was to group findings into higher-order categories (as shown in Figure 7), those categories denoting mainly separate variables such as control, drift, human agency, machine agency, etc.
Subsuming particulars into the general	In this case one asks if identified concepts or events belong to a more general class. Subsuming variables into more general classes involves the going back and forth between first-level data and more general categories, which develop through successive iterations until they are saturated.	This in the current research was carried out with the move from the first pass of coding to the second pass of coding, the first of which was more data driven, while the second of which was more theory-driven.
Factoring	This refers to techniques for reducing data and finding patterns in them. These techniques include the previously defined clustering, making metaphors and abstracting, which are all involved with finding patterns. These patterns “factor” disparate facts or words, and the processing is then called factoring.	Factoring in the current research was done by pattern coding within NVivo in the second phase of coding.
Noting relations between variables	This involves examining how variables relate to each other. Relationships can be detected with matrix displays, where data relevant to two or more variables can be included in the matrix and conclusions drawn.	Relations between variables (concepts) were examined in NVivo with conceptual matrices such as those presented in section 3.7.2.
Finding intervening variables	This refers to the case when an intermediate variable is needed to explain the relationships between two variables.	Intervening variables were not found in the elaboration of the concepts in the current research.
Building a logical chain of evidence	This refers to the classic procedure of analytic induction. In this case the evidence trail is constructed gradually, starting by getting an initial sense of the main factors, then tentatively plotting the relationships, and iteratively testing, modifying and refining them against the next collected set of data.	A logical chain of evidence was established by analyzing the sequence of events (implementation history, contextual factors) affecting ERP use. In addition, initial relationships between concepts (such as agency, control, drift) were developed for each company, with more data from other companies serving to further build and refine the relationships.
Making conceptual/theoretical coherence	This involves the following up of metaphors and interrelationships with constructs and theories.	Conceptual/theoretical coherence in the current research involved producing conceptualisations linking together the theoretical concepts used. This helped to explain the research questions of this study.